FLORA MALESIANA

SERIES I - SPERMATOPHYTA

Flowering Plants

Vol. 10, part 4

DEDICATION TO BLUME
ADDENDA

INDEX TO REVISED FAMILIES

TAXONOMICAL REVISIONS

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REPUBLIC OF INDONESIA
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FLORA MALESIANA

BEING
AN ILLUSTRATED SYSTEMATIC ACCOUNT OF THE MALESIAN FLORA / INCLUDING KEYS FOR DETERMINATION / DIAGNOSTIC DESCRIPTIONS / REFERENCES TO THE LITERATURE / SYNONYMY / AND DISTRIBUTION / AND NOTES ON THE ECOLOGY OF ITS WILD AND COMMONLY CULTIVATED PLANTS

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FOR THE PROMOTION OF
BOTANICAL SCIENCE AND THE CULTURAL ADVANCEMENT OF THE PEOPLES OF SOUTH-EASTERN ASIA TO THE SOUTHWEST PACIFIC REGION

SERIES I
SPERMATOPHYTA

VOLUME 10

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CONTENTS

TAXONOMICAL REVISIONS
in alphabetical sequence

ADDENDA
to volumes 4–10

INDEX

CAROLUS LUDOVICUS BLUME.

Dedicated to the memory of
CARL LUDWIG BLUME

DEDICATION[1]

Many botanists must have wondered why as yet no volume of *Flora Malesiana* was dedicated to the outstanding botanist CARL LUDWIG BLUME, undisputed pioneer in planning the compilation of a *'Flora Malesiana'*.

The writing of this Dedication would have been greatly facilitated if a full biography of BLUME had been existent, but none is available; there is not even a bibliography of his works. Only recently, in 1979, two biographical attempts were made, by J. MACLEAN and by A. DEN OUDEN, but only for the period 1820–1832; together with other biographical and obituary notes they are here assembled in Appendix B. I have also compiled a bibliography: Appendix A.[2]

There are various reasons to account for the lack of data. At Leiden there are, in the Rijksherbarium archives, only few letters addressed to or written by BLUME, and this is also the case for the University archives. Also TREUB (B) in his papers on the history of the Botanic Gardens at Bogor complained about the lack of correspondence of BLUME. The largest source of (official) letters is contained in the huge 'Rijksarchief' at The Hague, but it will require a large, time-consuming effort to unearth these (D: 5). BLUME's large private library was auctioned at Leipzig in March 1863, soon following his death, by the firm of O.T. WEIGEL (B; D: 9).

It has sometimes been suggested that the lack of a full biography – to which BLUME was certainly entitled – could be explained by the fact that BLUME had few friends (D: 8) and that his contemporary colleagues were antagonistic. But this explanation does not really hold, as a biography of the charismatic MIQUEL was not written before a century after his death. In the Netherlands the climate is not favourable for biographies of scientists, at least not in botany (D: 7).

For the reasons given above I have waited a long time to frame a worthy dedication, in the hope that some historiographer would feel attracted to compose a full biography of BLUME. In the absence of this I have ventured to accumulate material myself, recently supported by a study of MACLEAN (B) on BLUME's years in Java and based on archival research in the 'Rijksarchief', and an unpublished essay by DEN OUDEN (B) on the same period based on details from several hundreds of letters in the same archives.

To my regret biographers frequently do not give sufficient attention to personality and motivations, but confine themselves to an appreciation of achievements. I have tried to form an opinion about this facet of BLUME. From BLUME's profuse writings much can be learned about his motivations and his attitude towards society and people. It stands beyond doubt – and that must soon have been realized by his contemporaries (E, F) – that in the science of botanical taxonomy BLUME was on a level with the great taxonomists of the previous century. But in the eyes of his close colleagues he was an autocratic, dominant, unsympathetic person, and this impression still lingers around his name and overshadows the singular value of his scientific work. His sharp pen and especially his fanatical pursuit of a monopolistic position for the Rijksherbarium estranged him from his surroundings. GODDIJN (B: 1931) has pointed this out very well.

My purpose in composing this dedication is to give a sketch of Blume's life, his work and his motivations in a detached way. Blume has a right to an impartial judgement; activities and personalities should be kept well apart. In a few cases, where there is lack of clarity about the interpretation of historical data, I will give BLUME the benefit of the doubt.

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(1) Shortly before his death in May 1976 the author of this Dedication and former Editor of Flora Malesiana, Professor C.G.G.J. VAN STEENIS, finished the text of the manuscript. He had the intention to use this biography of Blume to conclude volume 10 of the Flora. We wholeheartedly like to carry out his intention here. – The General Editor.

(2) The documentation here presented is recorded in six appendices: A. BLUME's publications annotated; B. Biographical sources; C. References to cited literature; D. Notes (mostly additional information considered useful to illustrate the situations under which BLUME had to work, his surroundings, personalia, etc.); E. Eponymy; F. Honorary distinctions and memberships.

The photograph on the opposite page is copied from Rumphia 3 (1847), BLUME sitting above his treasures of the Javanese flora, including *Nepenthes*, *Rafflesia*, *Rhizanthes*, orchids and a rattan, presumably *Plectocomia*, the picture dating from the time when he was at the height of his career.

Towards the end of the 18th century two earlier attempts to compile a Flora of Malesia were made, namely by FRANCISCO NOROÑA in 1786 and by LOUIS DESCHAMPS in 1794–1798 (B: VAN STEENIS & VAN STEENIS-KRUSEMAN, 1970; C: VAN STEENIS *c.s.*, 1954). Both attempts were abortive by the unfortunate loss of the material these collectors had made.

In the early 19th century the time had come for the more thorough exploration of the tropical floras, both in the New and in the Old World. In the Indies it was started by W. ROXBURGH and N. WALLICH. In Malesia there had been quite some botanical activity in RAFFLES' time, notably by W. JACK in Sumatra and by TH. HORSFIELD and L.T. LESCHENAULT DE LA TOUR in Java, but these researches had led only to publications by JACK.

The proper achievement fell to BLUME, after the establishment of the Botanic Gardens at Buitenzorg (Bogor) in 1817, where a year later BLUME started a research period of seven years which led to his brilliant scientific career.

CARL LUDWIG BLUME, born at Brunswick (Germany) on 9 June 1796, was a son of the merchant CHRISTIAAN NICOLAAS LUDWIG BLUME and of MELUSINE CAROLINE SOPHIE DRECHSLER. His father died before he was born and his mother died when he was five years old. He was an eager boy and was attracted by the study of pharmacy. To a high degree he was interested in travel books of foreign countries, a trend and interest possibly strongly developed in Germany since HUMBOLDT's time, known as the 'Wanderlust', a tendency perpetuated to the present day (D: 10). BLUME's interests were probably directed towards the many unexplored regions of the globe, including the tropics. By 1813 he used his heritance to buy clothes and equipment, and enlisted as a volunteer in the 'Lützowsche Jägercorps', fighting against the French. Later on he went to the Netherlands, where on 29 December 1814 the Medical Board of the Dutch Forces appointed him as a military apothecary of the second class. On 6 April 1815 he was placed with the ambulance of the second division of the mobile forces in Belgium. He was present at Waterloo. According to the military *Stamboeken* (Registers) he was an apothecary of the second class in the hospitals at Den Helder and Leiden between 1814 and 1817.

When in 1815 Prof. S.J. BRUGMANS was commissioned to bring back the collections of natural history from Paris to the Netherlands – collections which the French had taken there in 1795 – BLUME was appointed as his assistent.

In some way or other, young BLUME enjoyed the support of the Duchess of BRAUNSCHWEIG, financially and otherwise. She fostered his career and had recommended him to Prof. BRUGMANS († 1819), who urged BLUME – who had performed his task excellently – to study natural history and medicine. BLUME followed this advice and took a degree as Doctor of Medicine on 9 July 1817 at Leiden (A: 1817). Shortly before this date, apparently in view of his doctorate, BLUME finished his activities as an apothecary in the hospital at Leiden. On 17 October 1817 he returned in the service of the hospital as an M.D., after having obtained, on 6 October 1817, the degree of a health-officer of the second class of the forces and hospitals. On 11 January 1818 he was honourably discharged as a surgeon-major and on 28 March 1818 became a health-officer of the second class of the forces in the Netherlands East Indies. On 28 May 1818 followed the same appointment for the first class; he worked at Leiden till 17 March 1818.

Shortly after his arrival in Java, on 11 January 1819, BLUME was appointed deputy-director under C.G.C. REINWARDT in charge of the organization of Education, Medical service, Agriculture, Arts and Scientific investigation. He was then only 22 years old, but obviously highly esteemed for his ambition, zeal, knowledge and energy. His initial salary was *f* 500 annually. He lived in REINWARDT's house at Buitenzorg (Bogor), enlarged for this purpose, in the Botanic Gardens. He married the rich WILHELMINA NICOLASINA CRANSSEN. This marriage was obviously not very successful. He was divorced in April 1830 in Brussels and he remarried at the end of that month JOHANNA ALLETTA WILHELMINA WAARDENBURG, by whom he had 7 children.

At that time the Government was much concerned about serious tropical diseases, small-pox, typhoid, cholera, and in 1820 REINWARDT wrote a detailed report on the state of vaccination in the years 1818–1819. All civil servants were informed of the Government's intention to maintain and promote vaccination. BLUME was provisionally appointed 'Inspector of Vaccine' in 1819. He informed the Government that it was desirable to use indigenous plants instead of imported medicines which often lost their value during the long sea-voyage, and the Government requested him to make proposals.

In the seven years between 1819 and 1826 BLUME travelled widely in West and Central Java, as far east as Rembang, often accompanied by assistants, draughtsmen and interested persons, collecting plants and also animals; gathering information on all sorts of aspects, including the medicinal value of certain plants, inspecting epidemics, *etc.*; in short he was engaged in an overall, thorough scientific exploration.

He gathered many duplicates and his herbarium specimens are still in excellent condition. It has never become clear to me how these early explorers managed to dry and preserve their collections so well in the everwet tropics under the primitive conditions of the time, trekking from camp to camp (B: VAN STEENIS-KRUSEMAN, 1950).

In 1821/22 he was in Bantam in the company of the civil servant J.B. SPANOGHE; in 1822 he made a large exploration of Mt Salak; in 1823 of Mt Gedeh; in 1824 he made a large tour of inspection in the company of the clerk G.H. NAGEL, the gardener W. KENT, and the draughtsman A. LATOUR, to many places: Kuripan (near Bogor) with hotwells in limestone then surrounded by primary forest, Mt Seribu (hills SW. of Jakarta), then to the Krawang region (E. of Jakarta) eastwards to Indramayu, proceeding to Cheribon, ascending Mts Tjeremai, Tangkuban Prahu, Burangrang, going as far as Tegal. Furthermore, he explored the then completely forest-clad large island of Nusa Kambangan (S. Central Java) where he detected *Rafflesia*. In 1825 he was again in Rembang (Central Java), but also in Bantam, ascending Mt Parang.

These must have been hectic, creative years in BLUME's life. In view of later controversies I have listed these explorations, which show that BLUME covered a considerable part of West and Central Java, and that his travels partly covered the same habitats which had been visited by KUHL and VAN HASSELT, members of the 'Natuurkundige Commissie', but also went beyond these. The result was of course that the majority of species were collected by both parties.

In all probability BLUME studied, analyzed, and described his collections *in situ*, facilitating later publication. In addition to all this field work he published scientific reports on many of these explorations, in part made public in a number of letters which he wrote to the brothers NEES VON ESENBECK, published in the Regensburg journal *Flora* (A: 1823–1826).

Finally he compiled all this material in the voluminous *Bijdragen* (A: 1825–1827), containing the concise treatment of some 700 genera and about 2400 species, belonging to 170 families of flowering plants. This achievement is colossal, as he had only very few books at his disposal, *viz.* WILLDENOW, *Species Plantarum*, PERSOON, *Synopsis*, SPRENGEL, *Anleitung* and *Systema Vegetabilium*, DE JUSSIEU, *Familles des Plantes*, ROXBURGH, *Flora Indica* vol. 1, and W. JACK, *Malayan Miscellanies*. He had of course also at his disposal the works of RHEEDE and RUMPHIUS but they were of hardly any taxonomical use. He mentioned in his *Enumeratio* that he had seen the plates of NOROÑA, obviously of a set since lost, but could not have had much profit from them for his purpose.

The writing of the *Bijdragen* itself was a tremendous task, let alone the research incorporated in them, a great deal of the genera and species being new to science. This research work has appeared to be of very high quality, testified by the fact that a very large amount of his newly proposed genera still stand and that others, now merged with earlier described ones, were always good taxa and were later often still recognized as subgenera or sections. A great merit was that BLUME hardly ever failed to recognize their proper affinity and almost always placed them in the proper family, evidence of his great systematic capacity. In view of the rather primitive state of tropical botany in his time this deserves great respect. BLUME's skills in this field also appeared from a first attempt to construct a system of affinity for tropical orchids, laid down in the *Tabellen en Platen voor de Javaansche Orchideën* (A: 1825), issued in part simultaneously with fascicle 6 of the *Bij-*

dragen. He complained that he had had no access to contemporary literature on the family by R. Brown, C.S. Kunth, and L.M.A. du Petit Thouars, which he only received during the printing of his own system of the orchids. This first attempt was much later crowned with his monograph *Flora Javae. Nova Series* (A: 1858–1859) of the *Orchidaceae*, the largest and least known family of the Malesian flora.

In addition he published in the first five fascicles of the *Bijdragen* data on the useful and medicinal plants of the families treated.

Apart from his work with vaccination and his exploration and botanical research work, another duty had fallen to Blume, when he was in June 1822 appointed director of the Botanic Gardens at Buitenzorg (Bogor), at Reinwardt's request succeeding him. Reinwardt himself repatriated in that year. The annual salary was *f* 1000. This was a task in itself; besides enriching the garden with plants he collected during his own travels, he was also in contact with other gardens abroad, for instance at Mauritius and Calcutta, with the purpose of exchange.

Blume was well aware of the fact that he should attempt to stimulate our consulates in foreign countries to collect plants or seeds for the garden, a policy which he later also followed when he was director of the Rijksherbarium. For the Buitenzorg garden he wished to have more Chinese and Japanese species and to obtain material he wrote to the Dutch consul in Canton and the representative in Deshima (Japan). A year later, in 1824, he instructed the Dutch in Japan how to dispatch seeds and plants to Batavia (Jakarta).

Furthermore, Blume sent Javanese and other exotic plants in small baskets to the university gardens at Leiden, Utrecht and Ghent in the Netherlands and also dispatched seeds to the 'Société de Flore' at Brussels.

In 1823 Blume published the first *Catalogus van ... 's-Lands Plantentuin te Buitenzorg* (A). In the listing were many manuscript names of Reinwardt under the latter's name. Blume himself added several new genera under his own name with valid descriptions. Without doubt Blume was the botanical 'motor' of this catalogue, Reinwardt having been too much occupied by administrative and organizational matters, and besides having been previously occupied by his large exploration of eastern Malesia. It should be added that Reinwardt's plant-systematical knowledge was meagre (D: 8).

On 11 June 1822 Blume was also definitively appointed as 'Inspector of Vaccine' and had to attend to his medical-pharmaceutical duties as well. He reported on the virtues of hotwells in Krawang (A: 1825, 1839), gained information on the fight against cholera, *etc.* for which he initiated medical treatment, and paid attention to medicinal plants (A: 1825, 1832). On 12 August 1823 he was appointed commissioner of the civil health service. In short, his duties were manyfold and his achievements in these years are of tremendous proportion.

In 1824 Blume received permission to extend his research to all Dutch possessions in the East Indies and was allowed to publish in the journals of Dutch societies. The Government would pay for the printing of a book on botany, obviously the *Bijdragen*, with the provision that all discoveries, observations and prepared specimens would be the exclusive property of the Netherlands Government.

In a letter dated 6 August 1825, no. 365, Blume informed the Governor-General about the proposed publication of his large book *Flora Javae*, pointing out that this was urgent as other persons who had explored in the Netherlands Indies were already active in having their discoveries printed. These other persons were obviously the French explorer L.T. Leschenault, the American Th. Horsfield, and especially the British W. Roxburgh and W. Jack. He said that with the insecure life in the tropics, when so many fell an early victim to tropical diseases, he felt that he had to safeguard his research, the result of his extensive field work and observations for science. Therefore he had decided to publish the very concise *Bijdragen* in anticipation of the large work *Flora Javae* which he had in mind. He mentioned that his own health slightly deteriorated, but there is no evidence that he was ever seriously ill in Java (D: 11). The *Bijdragen* were certainly not merely a striving for priority.

It was then that years of negotiation started about financing the expensive *Flora Javae*. For its elaboration he requested a leave of three to four years in Europe, necessary for the acquisiton of information which the new literature and the comment of experienced botanists could offer, and this required visits to some of the famous herbaria in Europe. He offered to stay in Europe on part of his salary.

In September 1825 the Governor-General permitted him a two-years stay in the Netherlands, at one third of his pay. After a frustrated attempt of BLUME to ship a large amount of living material to the Netherlands, and an offer to pay for his own passage, the Government finally decided by 26 June 1826 to commission BLUME for two years leave to the Netherlands on half-pay. His medical activities and the vaccination were assigned to his colleague PEITCH and the botanical work in the Gardens would be looked after by the gardeners JAMES HOOPER and ALEXANDER ZIPPELIUS who, together, would be paid from the other half of BLUME's salary. These were times of poor economy in the kingdom.

BLUME took with him 29 cases of herbarium material, sailing in the ship 'Christina Bernardina', destination Brussels, then the capital of the kingdom. He had the good fortune that the ship arrived safely, so many earlier dispatches having been lost by shipwreck, for instance several of REINWARDT's. By the end of 1826 BLUME arrived in Holland. By far the main part of the collections were made by himself, minor ones were included, *e.g.* those made by REINWARDT in Java and East Malesia (Celebes, Moluccas, Timor), local Javanese collections made by the gardeners ZIPPELIUS, KENT and HOOPER in the vicinity of Buitenzorg, *etc.* It should be stressed, however, that none of the collections of KUHL and VAN HASSELT were included, as these were property of the 'Natuurkundige Commissie'. Later, in 1828, these latter collections were dispatched to the Museum of Natural History at Leiden by G. VAN RAALTEN, who had been taxidermist in the service of the 'Natuurkundige Commissie', assisting KUHL and VAN HASSELT. VAN RAALTEN was also a capable draughtsman; he died at Kupang (Timor) in 1829.

VAN BREDA's archive, now at the 'Hollandsche Maatschappij', Haarlem, contains a partial abstract of a letter dated 22 July 1825 by G. VAN RAALTEN (B: 1825), in which he complains that BLUME – who had inspected the orchids in the KUHL & VAN HASSELT herbarium – had noted which species had been depicted of their collections. He became afraid that BLUME's publication would precede the publication of the KUHL & VAN HASSELT plants and found this unfair. He felt extremely sorry for the misfortunes which befell KUHL and VAN HASSELT. This letter was certainly one of the arguments for later, unjust accusations that BLUME stole scientific property. VAN RAALTEN pointed out that BLUME had agreed with VAN HASSELT to work out the orchids jointly, which BLUME also acknowledged in his *Bijdragen*; in fact some 27 names have a dual authorship, as I have elucidated (B: VAN STEENIS, 1980). As a non-botanist VAN RAALTEN did not understand that in such unfortunate situations the dead have no claim unless they left manuscripts.

A testimony that BLUME, after his departure from Java, had no access to manuscripts or drawings of KUHL and VAN HASSELT is the fact that in the Bogor Library there is – or at least was, before World War II – a book containing drawings of KUHL & VAN HASSELT (on *Asclepiadaceae*, *Orchidaceae*, *etc.*); it is a further proof that BLUME did not have these documents (D: 1).

Still, the letter by VAN RAALTEN, which was badly understood and interpreted, had influence. Accusations and slander lead a long life, and are often eagerly reproduced by antagonists. Thus even TEMMINCK, the director of the Museum of Natural History at Leiden, wrote in 1828 – when the KUHL & VAN HASSELT herbarium was transferred to BLUME – that the latter should guarantee priority to the manuscript names of KUHL & VAN HASSELT in publishing, although TEMMINCK must have been quite well informed about the situation. I regret that SMIT (B: 1979) in his essay still accepted VAN RAALTEN's accusation.

On the arrival of BLUME in Brussels, he reported to D.J. VAN EWIJCK (1786–1855), administrator of Education, Arts and Sciences in the Department of the Interior, who was very much impressed by BLUME's personality and works. In December 1826 VAN EWIJCK spoke highly of BLUME, praised his diligence and knowledge and declared himself in favour of the *Flora Javae* plans. The Minister contacted his colleague of the Colonies, who in his turn applied to King Willem I. This was followed by endless discussions who would pay for the publication of *Flora Javae*. The result was that Blume received 7000 florins and that the Dutch Government would buy 50 copies (5 florins for each instalment), the Netherlands Indies' Government would buy 4 copies, and that he was allowed to appoint a draughtsman (Arckenhausen) for a period of four years. Blume had in mind to publish 250 instalments.

In the meantime Blume pursued his activities in Holland, continued the *Bijdragen*, and composed a new work under the title *Enumeratio plantarum Javae* . . . (A: 1827–1828). The treatment was more elaborate than that of the *Bijdragen*. It was published in Leiden. He mentioned on the title page that he had also used material from Kuhl and van Hasselt, but this is hardly possible as this came only available to him in 1828 (D: 1).

Blume dedicated the first volume to the Nees von Esenbecks at Regensburg, with whom he had early friendly relations for several years. Blume's frequent letters to them on his experiences in the exploration of Java were published in several volumes of the journal *Flora*, and he frequently sent them cryptogams, mosses and fungi; when he returned to Holland in 1826 he stuffed empty spaces in his cases between his parcels with moss samples, especially hepatics, which enabled Th.F.L. Nees von Esenbeck to publish on Javanese *Hepaticae* in 1830. Partly out of courtesy the latter published a paper on Javanese *Fungi*, with Blume as co-author (A: 1827). As a matter of fact Blume extended his interest distinctly to cryptogams, and earlier had already pictured and studied mosses and fungi himself in the field. This interest did not wane, because in 1841 he readily agreed with Zollinger to buy lichen collections from Java where Zollinger intended to explore.

The second volume of the *Enumeratio*, dedicated to W.J. Hooker, consists mostly of descriptions of *Pteridophyta*; in fact it is the first account of them in Java. It proves Blume's thorough botanical knowledge, because he was mostly versed in *Spermatophyta*. Notwithstanding that, this volume is as complete and its contents as accurate as that of the flowering plants, according to Hennipman (C: 1979).

When in 1828 Blume's leave came to an end, he requested discharge of his position as chief of the Civil Health Service. This was granted because he would continue to work on botany and would not return to Java.

By Royal Decree of 22 June 1828 he was granted from 1 July 1828 onwards an annual salary of 3000 florins for his services and an annual half-pay of 2000 florins, till he had obtained another position. Blume had to cede in this same year his immense collection of animals and insects to the Museum of Natural History at Leiden. As compensation he would receive an annuity (B: Gijzen, 1938).

The first two parts of *Flora Javae* appeared in Brussels, in 1828, under authority of Blume and his adjunct, Dr. J.B. Fischer. J.G.S. van Breda (C: 1827–1829), then professor at Ghent and by profession a zoologist, would participate, or at least elaborate, the *Orchidaceae* and *Asclepiadaceae*. For this purpose the drawings and descriptions of plants made by Kuhl and van Hasselt were also given to van Breda.

On 31 March 1829 the Rijksherbarium was founded at Brussels, with Blume as director, with the title of professor. One of his first actions was to instigate that the Botanic Gardens at Buitenzorg should regularly provide consignments of plants to the Rijksherbarium, and furthermore, that the members of the 'Natuurkundige Commissie' in the Indies should not distribute specimens to foreign herbaria.

The Rijksherbarium did not long exist at Brussels because of the 1830 rebellion, and was saved in the nick of time and transported to Leiden by Fischer and von Siebold. This subject has been fully reported by my wife (C: van Steenis-Kruseman, 1962). Blume himself was not on the spot, because he was on his honeymoon to Geneva. He combined this tour with the object of inspecting the Roemer herbarium, which was for sale, to see whether it was worth-while to purchase it for the Rijksherbarium collections.

The Rijksherbarium, after its transfer to Leiden, was at that time not affiliated to the University, but was subjected immediately to the Ministry of the Interior. That Ministry drafted an Instruction for the director, effective from the first of January, 1831 (C: VAN DAM, 1832).

BLUME continued the issue of *Flora Javae*. Mid-1830 35 instalments had been published. Unfortunately, the subscriptions appeared insufficient and money ran out, and the work was temporarily abandoned.

BLUME did his best to expand the Rijksherbarium collections on a large scale. Via the Ministry of Foreign Affairs he urged civil servants abroad and in the colonies to collect plants and make herbaria.[1] For this purpose he composed a booklet of instruction (of which I have not been able to trace a copy) on how plants should be made into a herbarium, as drying plants in the tropics brings along difficulties by the moist climate and the often bulky and/or fleshy structure of the material. Moreover, there was the problem of frequent insect damage once plants are dried.

With some people BLUME succeeded. There is *e.g.* a large collection of several hundreds of specimens made by the Dutch consul in Venezuela, J.G. VAN LANDSBERGE, made in 1842. This collection is arranged by families, but remains unidentified to the present; it contains many duplicates. On the whole, however, BLUME's urging did not meet with great success.

BLUME also approached missionaries to collect plants in their territory, and stimulated pharmacists to do the same; those whom he tutored at Leiden he gave special attention and instruction. Although in this way many people sent overseas were aware of his wishes, the results were very meagre, as compared for example with the results of F. VON MUELLER in Australia in his contacts with missionaries. The latter's success is probably to be ascribed to the fact that he maintained a very regular correspondence with them and kept them timely informed of results. Besides, VON MUELLER lived much closer to them.

In general, the attempt to acquire botanical material by stimulating an interest in the tropical flora among medical men and other residents in the colony and the collecting of specimens was, as far as I can judge, not successful either. The endeavour in itself was excellent, but possibly precocious in the early 19th century.

In addition BLUME was engaged in buying collections which were for sale. A curious, significant example was a collection of Javanese plants offered in 1837 for sale to the Government by the German physician J.G.H. KOLLMANN, who was in the service of the Dutch East Indian army. This offer was referred to BLUME who found to his great surprise that this collection contained also the set of duplicates (about 4000 specimens) which he had conscientiously left at the Botanic Gardens in Buitenzorg (C: VAN STEENIS-KRUSEMAN, 1950; D: 4).

It should be borne in mind that it was factually impossible for BLUME to work on incoming collections without having a large staff of botanists at his disposal. From numerous letters in the 'Rijksarchief' it is evident that he pleaded time and again for the appointment of staff officers. Notwithstanding the esteem he was held in by the Ministry of the Interior and the sympathy of some high officials, notably VAN EWIJCK, it was of no avail. He could not even attain a permanent position for his two closest collaborators, Dr. J.B. FISCHER and his draughtsman and handy-man J.C.P. ARCKENHAUSEN (C: GRIEP *c.s.*, 1977; D: 12). Financially the Netherlands were at that time at low ebb. BLUME, moreover, was unfortunate with respect to the few scientific co-operators he had. VAN HASSELT and FISCHER met untimely deaths and VAN BREDA took another job.

Members of the 'Natuurkundige Commissie' were entitled to work out the results after seven years of exploration in the East Indies, but in this category it was only P.W. KORTHALS who performed excellent work. KORTHALS was possibly a modest man, in the shadow of BLUME, but his work in the field and in science was of the same high quality. KORTHALS would have been an excellent staff member, but after his retirement he devoted his time to philosophical contemplation,

(1) A. DE CANDOLLE mentioned (B: 1862) that BLUME told him the Netherlands Indies' Government had ordered, at BLUME's request, that all physicians in their service should have A.P. DE CANDOLLE's essay *Sur les propriétés des plantes* (1816) as a botanical guide.

as became evident from Zollinger's diary. Blume cannot be blamed for the fact that Korthals abandoned botany (B: Zollinger, 1841; D: 8).

H. van Hall had worked with Blume on a temporary basis from about 1850, but was only officially appointed adjunct-director in 1854, the only permanent scientific collaborator Blume was ever allowed.

Deficiency of technical staff was another drawback; here again attempts to expand failed. Apart from his draughtsman Arckenhausen technical assistants were few. This must in my opinion be one of the main reasons that hardly any duplicates were distributed in order to exchange material with foreign institutes to enrich the Rijksherbarium. Foreign colleagues complained that Blume asked for their material, but seldom gave a return. This greedy and monopolistic attitude made him unsympathetic. Evil tongues claimed that it was Blume's intention not to distribute duplicates, as he wanted to prevent new species to be described by others. I cannot believe this to be correct for in any case he could have distributed duplicates of species already described by himself. Obviously Blume was not in favour of seeing undescribed species published on duplicates. Not until the 1860s, under Miquel's directorship, numerous duplicates were distributed, partly unnamed. The same open policy was followed by the Herbarium Bogoriense (with an exception of selected Javanese collections made by C.A. Backer) and this more generous attitude was also kept up by Merrill in Manila, and from Miquel onwards by the Rijksherbarium. In the first place this is done for the greater safety of the collections (in that respect we have but to think of the disastrous effect of the fires in Berlin and Manila) but also because all research on Malesian plants must be welcomed, irrespective where and by whom. It is self-evident that in case of free-for-all descriptions a lot depends on the quality of the collaborators. It is true that not infrequently mediocre or uncritical collaborators have created more extra work rather than solved the problems for their successors.

A great inconvenience associated with duplicates of the early Dutch collectors was the fact that they were not numbered, neither by Blume himself, nor by Korthals, Reinwardt, or others. Through this, typification is difficult and it is sometimes impossible to know which duplicates belong to which collection. The more praiseworthy a Teijsmann, who consecutively numbered the Buitenzorg collections! But then the latter had more personnel. Blume's limited staff was certainly one of the reasons that the numerous collections remained undivided. Whom could he trust to distribute the unmounted collections in a responsible way?

As already mentioned it was not before the 1860's that Miquel, Blume's successor, instigated the policy of free distribution of duplicates, but certainly did not do it himself; he had it done by technical personnel. Without doubt the distribution of duplicates was extremely important as the result was the acquisition of numerous duplicates in exchange from foreign herbaria in Europe. It is a pity that this distribution lacked carefulness as regards the labels. Occasionally specimens with Blume's handwriting were sent elsewhere, for instance to Paris, while specimens retained at Leiden have labels written by a clerk. This is not seldom a nuisance in connection with the assignment of the holotype. Sometimes the use of wrongly printed labels is confusing, for instance of Korthals specimens of which sometimes 'Sumatra'-labelled plants are really from SE. Borneo. At Blume's and Miquel's times most of the Malesian collections were not mounted; this was only done towards the end of the 19th century.

As the prime botanist he was, Blume's interests were by no means restricted to those of a scientist working in seclusion. He was always keen on the development of the colony towards better living and status. He stressed the importance of promoting the cultivation of plants not only in the interest of big enterprise, but he held the opinion that there had to be a balanced situation for the benefit of all! This comprised also the introduction of new, useful plants. If one reads his general papers it appears that he had wide interests from his early stay in Java onwards. In the first five instalments of the *Bijdragen* he provided families with notes on their useful species. He wrote a monograph on the peppers (A: 1826) and as early as 1820 he took the initiative to advise the Government on the importance of cultivating indigo and of importing cochineal, and last but not least to import *Cinchona*, which materialized only three decades later through Hasskarl. In many papers he advocated more activity in agricultural matters and stressed the importance for national well-being in commercial, hence financial, aspects, for the Dutch as well as for the native people.

As a medical man, in his capacity of 'Inspector of Vaccine', and during his many travels, BLUME was of course in intimate contact with the Javanese people and he took their welfare as much to heart as that of the Dutch people; he clearly regarded them all as co-citizens. For example, he pleaded openly in a letter to the Governor-General of the Indies (A: 1829) for the desirability of abolishing opium, as he found this a menace for the population; only much later this was regulated indeed by the Opium Law.

In 1842 BLUME founded, together with PH.F. VON SIEBOLD and on the instigation of J. PIEROT, the 'Société Royale pour l'Encouragement de l'Horticulture dans les Pays-Bas' (Royal Dutch Society for the Advancement of Horticulture). This was part of his endeavour to make botany subservient to the general interest of the kingdom and to create a stimulant for new financial and commercial interests. In a first issue of the above-mentioned 'Societé' (A: 1844) he compiled a large list of useful plant species. Also later he showed his unfailing devotion by a stimulating paper on timbers resistant to pile-worm (A: 1859).

Altogether he held enlightened, progressive ideas – not so popular in those days – and in his opinion the native people ought to have their share of welfare, not in the least because their man-power was an essential aspect of a prosperous colony. In this respect it is significant that he named the genus *Santiria* after Bapa SANTIR, an old Sundanese, who accompanied BLUME on his explorations of Mt Salak. It was JUNGHUHN who took this amiss (B: JUNGHUHN, 1853) and suggested that BLUME was consciously deceptive in pretending to be generous, but really threw a blame on great botanists and other dignified man who were the only persons entitled to be honoured by eponymy. In his colonial arrogance JUNGHUHN called Bapa SANTIR an inferior person, not more than a simple *'pakkedrager'* (*kuli*, carrier), whereas in all probability Bapa SANTIR was an intelligent man and an outstanding local authority on plants who knew his way in the forest, knew the vernacular names and uses of forest plants and assisted BLUME in many ways. It is testimony of the irony of fate because in history JUNGHUHN is reputed to be the pioneer and advocate of a progressive society of freethinkers, whereas BLUME is remembered as a distinctly conservative person, though all his writings give evidence of a progressive, liberal mentality. It appeared that BLUME, *mirabile dictu*, was the more enlightened of the two; he was certainly devoid of any racial prejudice.

In 1843 BLUME started the journal *De Indische Bij*, another endeavour to promote an interest among the Dutch public in the understanding of the colony. Only one volume was issued (1843), mainly filled with papers by himself and his friend C.F.E. PRAETORIUS, Director of Cultures in Java, on all kind of subjects, partly political, partly ethnographical, on Borneo and South Sumatra, and on plant fibres.

Returning to BLUME's scientific works: in spite of the untimely abandoning of his *Flora Javae*, he set up another large-scale work in the thirties, *Rumphia*, the scope of which included also other parts of Malesia. The first fascicle appeared in 1836. It consisted finally of four volumes (1836–1849). This work was of the same critical standing as *Flora Javae*, to which it was similar in size and printing. In a sense it is an attempt towards a *Flora Malesiana*. Towards the end of the forties BLUME again managed to issue some important parts of *Flora Javae*, namely the *Filices* (instalments 36–39 in 1847 and 40 in 1851) and the *Loranthaceae* (instalments 41 & 42 in 1851). How these issues and *Rumphia* were financed is unknown to me.

The abrupt end of *Flora Javae* was regrettable and H.C. VAN HALL, professor of botany at Groningen, was much concerned about its continuation, which he found of national importance (C: VAN HALL, 1856). In a session of the Royal Academy of 28 June 1856 he proposed that this lofty body might form a committee to approach BLUME in order to come to a proposal from the Academy to the Government for further financing *Flora Javae*; at that time 42 instalments, each with 6 plates, had been issued. I do not know if VAN HALL's pleading led to any further action, but it shows that *Flora Javae* had supporters.

After Blume's death there obviously remained illustrated printed material for a continuation of *Flora Javae*. These 23 coloured plates, called *Planches inédites*, mostly represented species of *Loranthaceae* and *Ericaceae*, all provided with analyses. They were offered for sale as a packet by the firm van der Hoek, Leiden, in 1862 or 1863 (A: 1863; C: van Steenis, 1947).

Towards the end of the forties, when Blume was in his prime, he must have been disappointed with the untimely discontinuation of the two works on which he had set his heart, *Flora Javae* and *Rumphia*, and the insufficient public interest in his journal *De Indische Bij*. Moreover, clouds had gradually gathered round his claim that the Rijksherbarium had the monopoly for housing and possessing all collections made in the colonies by persons in the pay of the Government. He based this claim on the Instruction for the Rijksherbarium of 1832. This claim, however, was an optimistically exaggerated interpretation of art. 10 of this instruction which read (transl.): 'The Director will attempt to acquire collections, notes and drawings from all civil servants or people in the pay of the Government through proposals at the proper place and authority' (C: van Dam, 1832). Blume may have had a moral right to claim these collections, but could not refer to a legal right. His claim was not attended to and this must have been a thorn in his flesh.

Blume opposed the founding of Herbarium Bogoriense by Teijsmann in 1844, claiming that the latter should send the specimens to the Rijksherbarium, or at least the duplicates, but he found insufficient understanding with Teijsmann, who foresaw that he would have little profit from this in the way of a speedy naming of the specimens. Furthermore, Teijsmann's assistant, J.K. Hasskarl, had assembled a large private herbarium which he took with him on repatriation to Germany. Then von Siebold's herbarium was elaborated at Munich by Zuccarini (D: 2) where the types were left. W.H. de Vriese, professor at Amsterdam, had acquired the herbarium of Splitgerber, made in Surinam, but had not donated this to the Rijksherbarium. Finally, Junghuhn, officially belonging to the medical department in Java, had assembled a very large herbarium in Java, which Blume could not get into his hands (D: 3). It was purchased by Leiden University, under the condition that it should not be incorporated in the Rijksherbarium; it was entrusted to de Vriese. Finally, there was the rising star of tropical botany, F.A.W. Miquel, who originally published valuable monographs of *Piperaceae, Cycadaceae, Casuarinaceae, Melocacti* (partly for de Candolle's *Prodromus*), and later elaborated various large families in Martius' *Flora Brasiliensis*. He became also more and more interested in Asiatic plants, starting with his *Analecta Botanica Indica*, published by the Royal Academy. Miquel was a man of immense output and diligent handling of material, with an open mind for collaboration, which he brought in practice himself. Considering that, if the Junghuhn collection fell into Blume's hands, identifications would be endlessly retarded, combined with Junghuhn's natural desire that it should be speedily worked out, de Vriese reasonably entrusted Junghuhn's collection for this purpose to Miquel. With elaborate support (*e.g.* Bentham's), the latter indeed published the *Plantae Junghuhnianae*. This must have caused immense irritation to Blume, who was constantly on the barricades defending his institute, stressing again and again that collections made by government officials with government money ought to be deposited in the Rijksherbarium. This monopoly also concerned himself. My wife (C: van Steenis-Kruseman, 1979: 51) wrote: 'whatever has been said to Blume's discredit, one thing is certain, and that is, that he was possibly the only botanist (and a devoted, not to say inspired one) in his period who had no private herbarium.'

It is ironic but true that Blume's strict monopolistic claims made people reluctant to put their collections under his care, though Blume was, although not legally, at least morally in his rights. Even admitting that his claims were correct, it must be said that he should have realized that, if all these collections had been donated to the Rijksherbarium, he could as a single person never have mastered them. This would have been necessary, as some people wanted names and identifications. He should have tried to compromise and initiate collaboration and division of labour, at least with Miquel and de Vriese, and not sit tight-fisted on propriety of collections. But obviously he could not well adjust himself to the changing conditions of the times and the rise of capable colleagues in his specialized field. This led to most unfortunate friction and a clash of personalities. He offended especially JUNGHUHN in writing with his sharp pen an acid comment in *Rumphia* (1847 or 1849?) on JUNGHUHN's so-called *Lycopodium arboreum* which he had 'at first sight' recognized as belonging to the conifer genus *Dacrydium*, and BLUME renamed *Primula imperialis* JUNGH. as *P. Kuhlii* BLUME, claiming that KUHL had found this first and thus had priority for eponymy, nomenclaturally wrong of course. JUNGHUHN complained that BLUME begrudged him to describe *Acer javanicum* and had renamed this wrongly *A. niveum*, in which JUNGHUHN in turn was wrong. In short, about 1850 the fight was on and several very sharp and polemic papers were published to and fro (D: 13).

The unfortunate result was that BLUME became a still more isolated and probably a rather embittered person. Apart from odd fascicles of *Flora Javae* and *Rumphia* he had no opportunity for further great undertakings. He then put himself to proceed with a subject, stipulated in the 1832 Instruction for the Rijksherbarium, namely compiling a catalogue of the collections of that herbarium. As this implied identifications, this was not a clerical task for a non-botanist. My wife mentioned (C: VAN STEENIS-KRUSEMAN, 1979: 35) that the scientific arrangement of the collections was started by J. PIEROT (1831–1840), who was succeeded by J.H. MOLKENBOER (assisted by C. KERBERT and SCHULTES Jr, the son of J.A. SCHULTES) (1840–1846), and finally by H. VAN HALL (1853–1862). Their work of course facilitated BLUME's later *Museum Botanicum*. These helpers were named 'assistants', only VAN HALL was designated the title 'conservator'.

In December 1850 BLUME had to face an official new Instruction for managing the Rijksherbarium collections (C: THORBECKE, 1850). This was to meet official complaints by DE VRIESE, JUNGHUHN and VON SIEBOLD and especially MIQUEL, all influential persons, who wanted to borrow material, requests only reluctantly given in to by BLUME. MIQUEL wrote to VON SCHLECHTENDAL (B: STAFLEU, 1970: 321): 'Es ist mir endlich gelungen, das Reichs Herbarium zu öffnen. Nach einem Befehl der Regierung sind die Samml. aus Borneo, die noch ganz unbearbeitet waren, mir zur Disposition gestellt.' BLUME was ordered to proceed with the catalogue; no unicates were to be removed from the collections; furthermore, the director had to refrain from publishing discoveries by still living persons of the former 'Natuurkundige Commissie', unless with their consent. It must have irritated him considerably that responsibility and authority were restricted.

The catalogue, named *Museum Botanicum*, was printed in fascicles, all filling one sheet (16 pages), apparently with the intention to publish the fascicles monthly. It consists of two volumes in which the fascicles of volume one are dated by the year and month. The first volume was dated from 1849 to 1852 and finished with an index. The second volume was started with a fascicle dated 1852, but fascicles 2–8 are undated, fascicles 9–16 being dated November 1855 to June 1856. There was no index; this was later composed by myself and CHEW WEE LEK (C: VAN STEENIS & CHEW WEE LEK, 1974). As BEUMÉE (B: 1948) and STAFLEU & COWAN (B: 1976) have pointed out there are discrepancies about the dates of publication and this induced the latter towards suggesting that BLUME withheld literature from his colleagues (MIQUEL, WEDDELL, *etc.*) and that in other cases the possibility of antedating cannot be excluded. MIQUEL (B: 1856) severely criticized the doubtful datings of the fascicles. It is quite probable that not every fascicle was for sale at the published date, but sold in lots, and confusion remains. In the absence of well-founded data regarding the authority which paid for the publication, who arranged the sale, and whether one could subscribe, we must refrain from further comments (D: 6). Possibly BLUME still had a manuscript for one other fascicle which is known as *Mélanges botaniques* (A: 1855). Up till the present it was assumed not to have been effectively published. This is, however, wrong, as I have discussed earlier (B: VAN STEENIS, 1986). The pamphlet was privately published and donated by BLUME to his close friends; at least two copies still exist.

The *Museum Botanicum* is an important, critical work; it contains some attempts towards revisions and, though species and genera from all over the tropics were dealt with, the main text refers to the Malesian flora. We do not know why the *Museum Botanicum* was rather abruptly abandoned. It is not unthinkable that BLUME wanted to unburden himself from his old love, the *Orchidaceae*, and saw an opportunity to publish this masterly work which he had had constantly in mind since his early Buitenzorg years. This work had been interrupted several times, first when his collaboration with van Hasselt came to an untimely end by the latter's death, and later by the early leaving of van Breda. Now it was published as *Flora Javae, Nova Series* (A: 1858–1859). There is also a French-titled edition, with a preface in French, but otherwise identical. According to W.E.G. Seemann (B: 1859) Blume complained that the Government had not contributed to its financing; obviously Blume, who was a man of means, had taken the risk of financing it himself. Besides the excellent works of R. Brown, Lindley and Reichenbach on the *Orchidaceae* and the affinities within the family, also Blume's work is very important and of similar standing, and naturally of special importance for Malesian botany.

Blume, naturalized as a Dutch citizen in 1851, died in Leiden, after a long, painful illness on February 3, 1862, at the age of 65.

As said before, Blume is through his large oeuvre – including eight important and critical botanical works of high standard: the *Catalogus*, the monograph on *Piperaceae*, the *Bijdragen*, the *Enumeratio*, *Flora Javae*, *Rumphia*, *Museum Botanicum*, and *Flora Javae, Nova Series* – one of the great botanists of the former century. A ninth treatise, on cholera in Asia (A: 1831), is medical.

His creative output is imposing. He distinguished eight new families, to wit, *Apostasiaceae* (now mostly judged a subfamily among *Orchidaceae*), *Burmanniaceae*, *Cardiopteridaceae*, *Dipterocarpacaeae*, *Hernandiaceae*, *Myricaceae*, *Sabiaceae*, and *Schisandraceae*. In addition he described, from Malesia alone, some 300 new genera of which 160 are still used, and 140 are now in synonymy, either for reasons of nomenclature or for new systematical insights. However, they were all proper taxa and are still frequently recognized as infrageneric taxa, *e.g. Tarrietia* and *Campanumoea*. Furthermore, he described his genera and species almost always in the proper families *cq.* genera, testimony of his systematic vision.

As to his scientific achievement, his talent was soon recognized, both in Holland and abroad and he was soon made a member of learned societies (F). As usual for members of the 'Leopoldina', they should have a cognomen; Blume took for himself the well-chosen name Rumphius Secundus.

Many generic names (E) and very many species were named after him. We are pleased that the journal of the Rijksherbarium, *Blumea*, is named after him.

As an explorer Blume was exemplary in multidisciplinary approach by making observations on the spot, having a draughtsman with him, interrogating the native people about the uses and vernacular names, collecting insects and other animals, and paying attention to soils, mineral wells, *etc.*, and by timely reporting about his field research, a good habit which young explorers of the present day should take more to heart. Through his medical profession he made also observations about native diseases and tried to cope with these to relieve suffering of the people.

All his endeavours in this field and also his many advices on agricultural and horticultural affairs were focussed on tying up scientific botany and practice for the benefit of society. As such he was the opposite of the scholar in the ivory tower. His sharp observation power paired with interest were not confined to botany, as appears from his conclusions on serious contagious diseases among which cholera and typhoid were the most dangerous. As 'Inspector of Vaccine' he went to Central Java on inspection during a cholera epidemic and observed that the disease was especially prevalent in the lower lands, and less so in villages in the mountains. He deduced that cholera was spread by the polluted water and that the freshwater wells in the mountains were less contaminated. He prescribed all sorts of simple means for a diet and medicinal substances from native plants, but in the first place he advised boiling the drinking-water, and optionally adding some cinnamon in polluted areas. When settled at Leiden Blume published a book on Asiatic cholera (A: 1831). Shortly after, he attended a congress of naturalists and surgeons at Halle, a town at that time suffering from a serious epidemic of cholera. He observed that in the rather isolated 'Franckische Stiftung', a community of some 1800 souls, there was no cholera. These people were followers of the pietist A.H. Francke, founder of this 'Stiftung' in 1663. To his satisfaction he observed that this group of people got its own water from wells through a system of tubes several miles outside Halle. In Holland, where at that time cholera also was a serious disease, he noted that it was rare in the southwestern island province of Zeeland, and he correlated this with the fact that drinking-water there was mostly rainwater. The next year he wrote a pamphlet (A: 1832) on the subject which he had printed in 1000 copies at his own expense. He forwarded free copies to all municipalities, stressing that boiling all drinking-water was the simple remedy. One would expect that the arguments for this cheap advice were immediately accepted, and at least tested. But his opinion was completely overruled by the powerful voice of G.J. MULDER, a chemist of great influence, who declared that BLUME's conclusions were nonsense and that all water from ditches and canals was fit for drinking and had nothing to do with the dispersion of cholera. BLUME's role looks to me similar to the one of SEMMELWEISS in Vienna and his fight against puerperal fever. Thirty years later BLUME's conclusions were of course fully accepted.

As a civil servant BLUME excelled in activity for the benefit of the country and colony, in promoting the interests of agriculture and horticulture, throughout his life. As a director of the Rijksherbarium he did all he could under the circumstances, to raise it to a first-rate institution. As my wife (C: VAN STEENIS-KRUSEMAN, 1979: 37) put forward, BLUME succeeded in greatly enriching the Rijksherbarium with important standard collections, *e.g.* SPANOGHE (Timor), KORTHALS (W. Malesia), FORSTEN (Celebes), VON SIEBOLD, TEXTOR and BÜRGER (Japan), SIEBER, SCHULTES, CUMING, PERSOON, DOZY, and MOLKENBOER (Bryophytes). Besides this, he acquired large sets of duplicates from the collections of WALLICH, ECKLON & DREGE (Cape), and *Plantae Preissianae* (Australia). He purchased also several smaller collections from South America.

In the preceding pages I hope to have succeeded in making it clear that the slander of which BLUME was a victim was unfounded and can be defused by factual evidence.

I will now proceed with some remarks on BLUME's personality and his motives, as an addition to what already may transpire from the precedings pages. Much can be learned about this from his published papers. A perusal of his personal letters to his colleagues abroad will add probably more but this falls beyond my capacity. Another source is the opinion of third parties which can be found, for instance, in biographical papers. However, the latter are mostly an evaluation of the quantity and quality of achievements and seldom enter into personal facets. Among the obituaries of BLUME only GODDIJN (B: 1931) ventilated some well-considered remarks.

BLUME was a most intelligent person devoted to science and with a broad outlook, dedicated to promote the interests of his second fatherland and all its inhabitants. He pleaded for a society in which everyone, irrespective of race, should benefit from increasing profit. He was antagonistic to the idea of a 'Cultuurstelsel' [1] and pleaded for a free society.

As to his social contacts, it is difficult to ascertain much factual evidence without having access to his personal correspondence. His family life seems to have been happy and his wife sometimes shared his stays abroad. In Java he had good friends, *e.g.* PRAETORIUS, SPANOGHE and several others. As to his contacts with foreign colleagues, BLUME apparently often took part in the annual 'Versammlung Deutscher Naturforscher und Aerzte' in Germany.

In his native country he must have had friendly relations, among them the NEES VON ESENBECKS at Regensburg. According to ROLAND (B: 1944) he and his wife paid in September-October 1834 a lengthy visit to Paris where he had many friends (amongst others DECAISNE, BRONGNIART). He met many prominent personalities, compared material from Java of *Araceae*, *Annonaceae*, *etc.* with Paris collections, bought books, acquired and bought collections and frequently stayed with J.E. GAY (who had very rich collections) for studying material, often together with A. MOQUIN-TANDON, the monographer of *Chenopodiaceae*. The latter said of BLUME (B: ROLAND, 1944: 74):

(1) In the Netherlands East Indies the system in which the local people were forced to grow various sorts of crop suitable for the European market (in force mainly in Java, 1828–1890).

'Je suis sorti avec M. Blume dont j'aime beaucoup la figure gracieuse, la gaîté et la vitalité vraiment méridionale.'

The fact that so many honours befell him (F) indicates that he must have enjoyed the sympathy of many persons abroad who took the initiative to make the proposal. In political circles in Holland he certainly was also appreciated; the fact that he did not succeed in building up a staff of collaborators for which he pleaded in vain for two decades, can be ascribed to the rather poor economic situation of the kingdom, unfavourable for creating permanent scientific positions.

I believe that the later strenuous relations with his Leiden scientific contemporaries must, to a large part, be ascribed to feelings of envy towards his great capacities by the autocratic von Siebold and Junghuhn, the mediocre de Vriese and the frustrated Reinwardt and Hasskarl, who all eagerly grasped any opportunity to damage his image. In this they were in a way assisted by Blume's rigid, autocratic personality.

Unfortunately it is difficult to obtain more impartial contemporaneous information from neutral, disinterested parties. Among the rather neutral sources there is one, from the Swiss Heinrich Zollinger, who wrote an extensive diary which is now deposited in the Central Library at Zürich (B: Zollinger, 1841). The part of this diary relating to Zollinger's stay at Leiden, October to December 1841, was typed out and generously put at my disposal by Prof. Dr. H. Wanner, Zürich.

Zollinger, at the suggestion of A. de Candolle, was considering a botanical-zoological exploration of Java and wanted subscriptions from biologists, authorities, and institutes for his endeavour. After having obtained some in Switzerland, France, and Belgium, he came to Holland, in 1841, where Miquel gave him some hope. With his letters of recommendation he tried to obtain subscriptions from the Rijksherbarium and from the National Museum of Natural History at Leiden. Above all, he sollicited free transport for himself and his equipment to Java from the Dutch authorities as a contribution to his future work in the colony. In his diary Zollinger gave his free opinion on several scientists he visited (Reinwardt, Temminck, Schlegel, de Vriese, Ammann, Splitgerber, Schwaner, von Siebold, Korthals) (D: 8). He paid visits to Blume and noted about him (B: Zollinger, 1841: 25): 'Blume ist ein kleines, elegantes, vornehmes, lebhaftes Männchen, das sich auf verschiedene Weise ein grosses Vermögen und eine grosse Reputation erworben hat. Er war sehr freundlich und zuvorkommend, gab mir Räthe aller Art. Ob nun im Herzen es anders aussieht, warum er so gegen mich ist, weiss ich nicht. Ich will das Beste denken und auf meiner Huth sein'; l.c. 29: 'Er schwatzte mir freundlich vor, wie bis jetzt noch kein Privatunternehmen wie meines auf Java, gelungen. Wie ich dort nichts neues mehr finden werde, besonders im Westen; ich müsse mich zeitig nach einer Anstellung umsehen. Aus dem Ganzen schien mir hervorzugehen dass er mich ganz abzuhalten oder für den holländische Dienst zu gewinnen sucht; denn auf beide Weise kommt nichts in fremde Hände, oder im letzteren alles zuerst in die seinen'; *l.c.* 31 (summarized in English): von Siebold suggests that Blume is a rather tough person and reckons that Zollinger will anyway send him plants, obviously alluding to Blume's refusal to subscribe to a set of Zollinger's plants; *l.c.* 33: Blume subscribed to buy Lichenes from Java and offered him an iron trunk. He spent another evening in Blume's beautiful house, with a large library, but the trunk did not turn up. 'Blume hat fünf hübsche Kinder und eine hochgebildete Frau. Er zeigte mir seine Rumphia und andere Sachen, die auf Java bezug haben. Wir sprachen meist von Indien. Ich soll 3 Kisten (lebende) Pflanzen miterhalten' (obviously for the Botanic Gardens at Buitenzorg). At the advice of Blume he went to Mr. Arriens, a high official at The Hague, who suggested an audience with the Minister of the Navy, but Zollinger had no success; all he got was a permission to collect in the colony, antiquities excepted. In passing, Zollinger followed Blume's advice and sollicited to be attached to the Botanic Gardens at Buitenzorg, but there was no vacancy at that time. Thus, Zollinger had not much success at Leiden, as far as botany was concerned. It remains guesswork whether Blume could have achieved more for him if he had backed him up.

Summing up my impression of Blume's personality, it appears that he was not a social, amicable person, but self-centered and keeping aloof; also conscious of his capacities and dignity but lacking flexibility. However, his motives were honest, and this becomes clear from scanning his own writings and other literature, if judged against the background of his time and circumstances. It is true that he had a sharp pen and in defending the rights and interests of the Rijksherbarium his acid reprimanding of JUNGHUHN, no less a dominant authority than himself, unnecessarily hurt personally, which, to say the least, led to a severe estrangement.

However, the slander to which BLUME became a victim is unjustified, and may well have been induced by jealousy of his brilliant scientific achievements and envy of his monopolistic position at the Rijksherbarium. In my view BLUME was an enlightened scientist, whose image may hereby be restored.

C.G.G.J. VAN STEENIS

Appendix A – Blume's publications

1817 – *Dissertatio inauguralis medica, de Arsenico et Ratione qua in Animalia agit.* Leiden. 49 pp.
With verses by D.J. Veegens, a friend, and Prof. S.J. Brugmans.

1821 – *Minerale wateren van Tjipannas en Tjiradjas.*
Bataviaasche Courant, 15 Sept. 1821.
Repr. in Indisch Magazijn, Tweede Twaalftal, no 1/2, 1845: 162–166.
Contains a chemical analysis, obviously made by Blume himself, of the mineral contents of these waters.

1822 – *Gedachten op eene reize door het Zuid-Oostelijk gedeelte der Residentie Bantam.*
Bataviaasche Courant, 16 Febr. to 30 Nov. 1822.
Repr. in Indisch Magazijn, Tweede Twaalftal, nos 3/4, 1845: 1–36.
Report of trip, describing the history, anthropology, ethnography and politics of the Badui people in SW. Java. No botany involved.

1822 – *Beschrijving van de heilige graven der Badoeis in het Zuid-Oostelijk gedeelte der Residentie Bantam.*
This appeared as the chapter 'Mengelingen' in the Bataviaasche Courant, nos 7, 8, 10, 13, 27–29, and 32, 16 Febr. to 30 Nov. 1822.
Repr. in Indisch Magazijn, Tweede Twaalftal, nos 3/4, 1845: 1–36.
An ethnographical description of the Badui people in SW. Java, their sacred graves, *etc.* In the library of the Institute Taal-, Land- & Volkenkunde, Leiden University, there is a 85 pp. manuscript (H 75) with the title *'Gedachten op eene reize, in de maanden December en Januari jl., in het zuidoostelijke gedeelte der Residentie Bantam gedaan. Getrokken uit de Javaansche Couranten van 1822,'* which is probably copied *literatim.*

1823 – *Catalogus van eenige der merkwaardigste zoo in- als uitheemsche gewassen, te vinden in 's-Lands Plantentuin te Buitenzorg.* Batavia. 112 pp., 1 pl.
Several new genera and species. Many *nomina nuda* under Reinwardt's name.
Repr. in Arnold Arboretum 1946.

1823 – *Beschrijving van eenige gewassen, waargenomen op eenen togt naar den Salak in den jaare 1822.*
Verhand. Batav. Genootschap van K. & W. 9: 129–202.
Mostly descriptions of plants (*Magnoliaceae, Loranthaceae, Dipterocarpus, Cedrela, Piper, etc.*).

1823 – Letter to Nees von Esenbeck. Flora 6: 713–716.
Report on a planned trip in Java.

1823 – *Bijdrage tot de kennis onzer Javaansche eiken.*
Verhand. Batav. Genootschap van K. & W. 9: 203–223, 6 pl.
Account of *Quercus* in Java (incl. also *Lithocarpus*).

1823 – (with C.G. Nees von Esenbeck) *Pugillus plantarum Javanicarum, e Cryptogamicarum variis ordinibus selectus.*
Nova Acta Acad. Caes. Leop.-Carol. 11 (1): 117–138, pl. 12 & 13.
Descriptions of Pteridophytes, the new species under dual authorship 'Nees & Bl.'.

1824 – Letter to NEES VON ESENBECK: *Ueber die Vegetation des Berges Gedee auf der Insel Java.* Flora 7: 289–295.
Extract from a larger paper in Dutch, see below (1825). Sketches on the exploration of Mt Gedeh made together with the hortulanus KENT. BLUME did not ascend Mt Pangrango.

1824 – *Epidemie onder de buffels.*
Bataviaasche Courant, 10 Jan. 1824: 'Verslag van den kommissaris van den burgerlijk geneeskundigen Dienst in Nederlandsch Indië C.L. Blume.'
See also: Indisch Magazijn, Tweede Twaalftal, no 3/4, 1845: 91–94.
Epidemic disease among the buffaloes.

1825 – Letter to the Governor-General, dated 8 Dec. 1824, published in the Bataviaasche Courant, 12 Jan. 1825.
Report on BLUME's discovery of *Rafflesia* in Nusa Kambangan I. (S. Java), the first discovery of the genus in Java. He did not name it here.

1825 – *Bestijging van den berg Tjerimai, gewoonlijk genoemd Tjermé, in de Residentie Cheribon.*
Bataviaasche Courant, 2 Febr. 1825.
Repr. in Indisch Magazijn, Tweede Twaalftal, no 3/4, 1845: 102–116.
Report of a trip from Krawang eastwards to Panarukan, Linggadjati, culminating in the ascent of Mt Tjeremai, with many botanical data on plants encountered.

1825 – *Over de gesteldheid van het gebergte Gedeh.*
Verhand. Batav. Genootschap van K. & W. 10: 55–104.
Lively topographical and botanical description of an ascent of Mt Gedeh from Bogor via Puntjak, along Megamendung, Tjibeureum and Kandangbadak through the crater and along the Alun-Alun to the summit. BLUME did not ascend Mt Pangrango, and thus missed *Primula imperialis.*

1825 – *Inlandsche middelen tegen diarrheeën.*
Bataviaasche Courant, 23 Febr. 1825.
Native recipes against diarrhoea.
See also: Indisch Magazijn, Tweede Twaalftal, no 3/4, 1845: 116.

1825 – *Tabellen en Platen voor de Javaansche Orchideeën.* Batavia. 5 tab., 16 pl. Folio.
Famous exposition of a system of the Javanese orchids and their affinities; 73 spp. depicted in detail. Issued with the *Bijdragen* (1825–1827) part 6.

1825 – (with C.G. NEES VON ESENBECK & C.G.C. REINWARDT) *Hepaticae Javanicae editae conjunctis studiis et opera.*
Nova Acta Acad. Caes. Leop.-Carol. 12: 181–238, 409–417.
Account of hepatics in Java.

1825 – *Iets over de planten onder den naam van Patma, bij de Hindostaners en de Javanen bekend.*
Bataviaasche Courant, 9 March 1825.
Repr. in Indisch Magazijn, Tweede Twaalftal, no 3/4, 1845: 179–183.
A note on plants known under the vernacular name 'patma' (= *Rafflesia*).

1825 – *Korte beschrijving van de Patma der Javanen.*
Bataviaasche Courant, 23 March 1825 (22 pp., in L).
Repr. in Indisch Magazijn, Tweede Twaalftal, no 3/4, 1845: 183–194.
Short description of the 'patma' (= *Rafflesia*) of the Javanese.

1825 – *Die Patma-Pflanze der Indier und Javanesen und Beschreibung einer neu entdeckten Blume auf der Insel Noesa Kambangan, die an Grösse alle bis dahin bekannt gewesenen übertrifft.*
Liter. Wochenbl. der Börsenhalle, Hamburg, no 29: 454–462. Repr. in L.
As the preceding.

1825 – *Beiträge zur Kenntnis von Bantam, dem westlichsten Bezirk auf Java.*
Hertha II: 227–257.
Not seen. Probably similar to entries in 1822.

1825 – Letter to TH.F.L. NEES VON ESENBECK: *Reise von Batavia nach Krawang in der Preanger Regentschaft.* Flora 8 (2): 577–585.
Report of journey from Batavia to Krawang.

1825 – *Etwas über die Rhizantheae, eine neue Pflanzenfamilie, und die Gattung Rafflesia insbesondere.*
Flora 8 (2): 609–624.

1825 – Letter to TH.F.L. NEES VON ESENBECK: *Ueber Pflanzen der Gegend von Batavia.* Flora 8 (2): 676–680.
Flora of the vicinity of Batavia.

1825 – Letter to the Governor-General, dated 20 Nov., on the flowering of a new species of a new genus of *Araceae* with a very large inflorescence, obviously *Amorphophallus campanulatus*, in the Botanic Garden, with reference to *Tacca phallifera* RUMPH.
Bataviaasche Courant, 23 Nov. 1825.

1825–1827 – *Bijdragen tot de Flora van Nederlandsch Indië.* 17 fascicles, 1169 pp.
For publication dates, see STAFLEU & COWAN, Taxonomic literature, ed. 2, 1 (1976) 236.
In all 107 families are treated, in which 700 genera and over 2300 species were incorporated. There are many new genera and very many new species, all described in concise Latin. In the first 5 fascicles each family has also a paragraph with notes on its useful plants.
On p. 265 BLUME mentioned that his plan was to treat the orchids together with VAN HASSELT; 27 species out of the 296 were jointly described. Through VAN HASSELT's early death this joint venture was frustrated.
There is a typed Index to the names in L.
Data on useful plants mentioned in fascicle 1 were copied in Alg. Konst- en Letterbode 1826-1: 26–29, 37–41.

1826 – *Monographie der Oost-Indische pepersoorten.*
Verhand. Batav. Genootschap van K. & W. 11: 139–245, 6 pl., 41 fig.
Monography of Netherlands-Indian species of *Piper*.

1826 – *De Tacca Culat van Rumphius wedergevonden. Mededeeling van de waarnemingen van C.L.Blume.*
Alg. Konst- en Letterbode 1826-1: 333–334.

Report about BLUME's recollection of a Rumphian aroid in the island of Nusa Kambangan, S. Java: *Amorphophallus campanulatus.*

1826 – Letter to NEES VON ESENBECK: *Bruchstücke einer Reise auf der Insel Java.* Flora 9 (2): 417–426, 433–441.
Report on a trip in NW. Java, including also an ascent of Mt Tjeremai.

1827 – (with TH.F.L. NEES VON ESENBECK) *Fungi Javanici.*
Nova Acta Acad. Caes. Leop.-Carol. 13 (1): 9–22, pl. 2–7.

1827 – *Over een nieuw plantengeslacht, de Brugmansia, uit de natuurlijke familie der Rhizantheae.*
In: H.C. VAN HALL (ed.), Bijdragen tot de Natuurkundige Wetenschappen 2: 419–423.
Brugmansia, a new genus of the *Rafflesiaceae.*

1827 – *Observations sur le structure des poivres.*
Ann. Sc. Nat. 12: 216–224.
Extract in French of the monograph of *Piper* (1826).

1827 – *Bijdrage tot de kennis van het landschap Bantam, in het westelijk gedeelte van Java, etc.*
Cybele (Tijdschr. Bevordering Land- en Volkenkunde) VI^{e} stuk: 1–36.
Contribution to the knowledge of Bantam, West Java. Almost *literatim* reproduced under the same title in Indisch Magazijn, Tweede Twaalftal, no 3/4, 1845: 1–36.

1827 – *Over de staat der indigo-teelt.*
In: P. VAN GRIETHUIZEN, Over de staat der indigo-teelt. De Nederl. Hermes, Tijdschr. Koophandel, Zeevaart en Nijverheid 2, no 10: 40–42.
Brief information and references on cultivation of indigo.

1827–1828 – *Enumeratio plantarum Javae et insularum adjacentium minus cognitarum vel novarum ex herbariis Reinwardtii, Hasseltii, Kuhlii, Blumei, etc.* Leiden. 2 vols. 278 pp.
Description of some families of Angiosperms and the Pteridophytes. Properly a continuation of the *Bijdragen* (1825–1827), although in more detail and with longer descriptions. Repr. Den Haag 1830, Amsterdam 1968.

1828 – *Het Duizend-Gebergte (Goenong Seribu).*
In: G.H. NAGEL, Schetsen uit mijne Javaansche portefeuille; Javaansche tafereelen: 69–75 (in L).
Remarks on the landscape of the 'Thousand Hills', in the plain SW of Jakarta. Also a brief description of the limestone hills Kuripan, SW of Bogor, famous for their hotsprings, which yielded several plants not found anywhere else, amongst them a *Cycas* sp.

1828–1851 – *Flora Javae nec non insularum adjacentium.* Brussels. 3 vols.
Three sumptuous folio volumes, with analyses, plates, and descriptions in great detail. The authorship is partly ascribed to his assistant Dr. J.B. FISCHER, who was his 'adjutore'. The preface is probably most interesting, but being not in sufficient command of the Latin language, I cannot evaluate it.
For publication dates, see STAFLEU & COWAN, Taxonomic literature, ed. 2, 1 (1976) 236. 23 *Planches inédites* were for sale in probably 1863 (see also C: VAN STEENIS, 1947).

1829 – Letter to the Governor-General. Algemeen Handelsblad of April 1st, no 26.

On the occasion of the appointment of Governor-General VAN DEN BOSCH; on the importance of stimulating cultures for the general welfare, commerce, and the benefit of the common people. BLUME pleaded for the gradual abandoning *cq.* restriction of the use of opium.

1831 – *Reistogte naar Buitenzorg, het Duizend-Gebergte, Koeripan en in de omstreken van Batavia, 1824; door een ambtenaar.*
Recensent (de Recensenten) XXIV, 2: 427–442, 467–471.
This contribution is not written by BLUME himself, but by one of the civil servants accompanying him, A. ZIPPELIUS or A. LATOUR, on a trip to the hills W of Bogor. By BLUME himself also described in the entry of 1828, *Het Duizend-Gebergte.*
Contains no scientific observations.

1831 – *Ueber einige Ostindische, und besonders Javanische Melastomataceen.*
Flora 15 (2): 465–527.
A thorough study of the family *Melastomataceae* in which BLUME described 12 new genera, all standing to the present day, mainly based on species described in the *Bijdragen* (1825–1827).

1831 – *Over eenige Oost-Indische, byzonder Javaansche, Melastomataceae.*
In: H.C. VAN HALL (ed.), Bijdragen tot de Natuurkundige Wetenschappen 6: 211–268.
The same as the preceding entry.

1831 – *Eenige woorden over de redding van het Rijks Herbarium door Dr. J.B. Fischer.*
Alg. Konst- en Letterbode no 23, 10 June: 356–359 & no 24, 17 June: 374–377 (in L).
Details on the transfer of the Rijksherbarium from Brussels to Holland by Dr. J.B. FISCHER.

1831 – *Over de Asiatische cholera, uit eigene waarnemingen en echte stukken.* C.G. SULPKE, Amsterdam. viii + 203 pp. (In University Library at U).
Historical account and personal experience with cholera in the Netherlands Indies, extensively documented; measures taken by the government to cope with this disastrous illness.

1832 – *Vruchten mijner ondervinding in het afweren en genezen der cholera.* Amsterdam. 31 pp. (in L).
A most interesting paper prescribing how to deal with patients suffering from cholera, in Java called *febris endemica bataviae.* Recipes for external and internal use. Prescribing the boiling of drinking-water. Paper printed in 1000 copies at the author's expense, distributed freely to boards of municipalities in the Netherlands.

1832 – *Beschrijving van Calamus draco Willd., etc.*
In: H.C. VAN HALL (ed.), Bijdragen tot de Natuurkundige Wetenschappen 7: 115–129.
Extensive Latin description of a rattan from S. Sumatra collected by his friend C.F.E. PRAETORIUS.

1832 – *Uittreksel uit eenen brief van den Heer J.B. Spanoghe aan den hoogleeraar C.L. Blume.*
Alg. Konst- en Letterbode 1832-I: 356–361.
Notes on the situation in Bima (Sumbawa), with biographical notes on SPANOGHE by BLUME. Plant list of Bima.

1834 – *Observationes de genere Helicia Lour.*
Ann. Sc. Nat. sér. II, 1 (1) Bot.: 211–220.
Review of the genus, with new species.

1834 – *Eenige waarnemingen omtrent de Culilawan boom van Rumphius.*
Tijdschr. Natuurlijke Geschiedenis en Physiologie 1: 45–64, t. 2.
Repr. in: WIEGMAN, Archiv Naturgeschichte 1 (1835) 116–126, and in: Jahrb. Pharm. Berlin 35 (1835) 9–29.
On *Cinnamomum* described by RUMPHIUS.

1834 – *Eenige opmerkingen over de natuurlijke rangschikking van Rohdea, Tupistra en Aspidistra, als mede de beschrijving eener nieuwe soort van dit laatste geslacht.*
Tijdschr. Natuurlijke Geschiedenis en Physiologie 1: 67–85, pl. 3 & 4.
Botanical relations between three genera, and description of a new species of *Aspidistra.*

1834 – *De novis quibusdam plantarum familiis expositio et olim jam expositarum enumeratio.*
Tijdschr. Natuurlijke Geschiedenis en Physiologie 1: 131–162.
Repr. in Ann. Sc. Nat. sr. II, 2 Bot.: 89–106.
A preprint was issued in 1833, see STAFLEU & COWAN, Taxonomic literature, ed. 2, 1 (1976) 2367.
Description of a number of newly proposed families, *Apostasiaceae, etc.*, with a few new species.

1835 – *Neesia, genus plantarum javanicum repertum, descriptum et figura illustratum.*
Nova Acta Acad. Caes. Leop.-Carol. 17 (1): 73–84, pl. 6.
A new genus of *Bombacaceae* named after TH.FR.L. NEES VON ESENBECK.

1835–1848 – *Rumphia, sive commentationes botanicae imprimis de plantis Indiae orientalis, tum penitus incognitis tum quae in libris Rheedii, Rumphii, Roxburghii, Wallichii, aliorum, recensentur.* Leiden, Amsterdam. 4 vols. Folio.
For publication dates, see STAFLEU & COWAN, Taxonomic literature, ed. 2, 1 (1976) 238.
Conditions for sale were mentioned in Ann. Sc. Nat. sér. II, 4 (1835) 318.
JUNGHUHN mentions that part of the work was elaborated and illustrated by J. DECAISNE and the Latin was supervised by D.J. VEEGENS, a friend of BLUME.

1837 – *Levensbyzonderheden van Franz Junghuhn.*
Alg. Konst- en Letterbode 1837-II: 277, footnote.
Biographical notes on F. JUNGHUHN.

1837 – *Levensbyzonderheden van Dr A. Fritze.*
Alg. Konst- en Letterbode 1837-II: 277, footnote.
Biographical notes on A. FRITZE, Inspector of Physicians and benefactor of JUNGHUHN.

1837 – *Naschrift op den brief van Junghuhn uit Djocjakarta.*
Alg. Konst- en Letterbode 1837-II: 278–280.
Appendix to a letter of JUNGHUHN.

1838 – *Revue des palmiers de l'archipel des Indes orientales.*
Bull. Sc. Phys. & Natur. en Néerlande no 9: 61–67.
Repr. in Ann. Sc. Nat. sér. II, 10 Bot.: 369–377.

1838 – *Miquelia, genus novum plantarum javanicarum.*
Bull. Sc. Phys. & Natur. en Néerlande no 13: 93–95.
Repr. in Ann. Sc. Nat. sér. II, 10 Bot.: 255–256.

Description of a new genus of *Icacinaceae*, named after MIQUEL, then director of the Rotterdam Botanical Garden.

1838 – (transl.) Advertisement for sustaining the edition of Flora Javae, Rumphia, *etc.*
Alg. Konst- en Letterbode 1838-II: 322, 401.

1839 – *Beschrijving der minerale bronnen, welke nabij Tjiratjas in de Residentie Krawang worden gevonden.*
Tijdschr. Ned.-Indië 2 (1): 451–455.
Description of mineral wells near Tjiratjas in Krawang, E of Jakarta.

1843 – *Levensbyzonderheden over Th.St. Raffles.*
De Indische Bij 1: 49, footnote.
Praise of RAFFLES' humane government.

1843 – *Engeland's staatkunde omtrent China.*
De Indische Bij 1: 61–77.
To stimulate the necessity of increasing naval power in Netherlands-Indian waters and extend commercial relations with Japan. In a footnote on p. 76 BLUME refers again to the necessity of regulating the trade in opium.

1843 – *Toelichting aangaande de nasporingen op Borneo van G. Müller.*
De Indische Bij 1: 103–176.
On the geography, anthropology, commercial situation *etc.* of W. Borneo, from correspondence with G. MÜLLER. In a footnote on p. 104 BLUME reveals the bad management of the Governor-General DAENDELS, and he praises RAFFLES for his humane, unselfish administration.

1843 – *Bladvulling.*
De Indische Bij 1: 320.
An occasional note on common social progress, whereby also the native people should prosper. Private property of land by non-natives is discouraged. Native rule should not be undermined. Adat should be maintained.

1843 – *Over een Nederlandsch Gezantschap in Japan.*
De Indische Bij 1: 479–480.
Importance of a Netherlands Embassy in Japan.

1843 – *Over eenige Oost-Indische planten welke eene uitmuntende vezelstof opleveren, en Gedachten over het nut van dergelijke kulturen tot opbeuring van de buiten Java gelegene etablissementen.*
De Indische Bij 1: 481–509.
On the importance of fibres, from *ramie*, cotton and *Musa*; tissues provided by BLUME were examined.

1844 – (with P.F. VON SIEBOLD) *Ontwerp tot oprigting van de Koninklijke Nederlandsche Maatschappij tot Aanmoediging van den Tuinbouw.*
Jaarb. Ned. Mij. Aanmoed. Tuinbouw over 1844: iii–iv.
Tentative rules for the newly erected society.

1844 – *Over het nut der invoering van vreemde gewassen en de laatste pogingen om daardoor den tuinbouw hier te lande op te beuren.*
Jaarb. Ned. Mij. Aanmoed. Tuinbouw over 1844: 41–88.
On the use of importing exotic plants for horticulture in the Netherlands.

1844 – *Naamlijst van Oost-Indische en bepaaldelijk Javaansche gewassen, etc.*
Jaarb. Ned. Mij. Aanmoed. Tuinbouw over 1844: 88–90, t. 1–4 (col.).
Unsigned, but attributed to BLUME.

1844 – *Ueber das Lycopodium arboreum Jungh.*
Amtlicher Bericht über die Versammlung Deutscher Naturforscher und Aerzte Abt. 2, 22: 85–89.
Identified as *Dacrydium cf. elatum* WALL. on type material shown to him by W.H. DE VRIESE. In Rumphia 3 (1849) 219, 221 BLUME later added sour remarks.

1844 – *Ueber ein Surrogat des Chinesischen Thees.*
Amtlicher Bericht über die Versammlung Deutscher Naturforscher und Aerzte Abt. 2, 22: 90–92.
Made public in a session of the Society at Bremen, 23 Sept. 1844. As Prof. G.J. MULDER had shown the alkaloid theine is the same as caffeine, BLUME suggested that tea could be made from dried leaves of coffee.

1845 – *De Koffij-thee.*
Astrea, Tydschr. van Schoone Kunsten, Wetenschap en Letteren 1: 285.
Same as preceding.

1845 – *Minerale wateren van Tjipannas en Tjiradjas. Opmerkingen nopens de bruikbaarheid van dien te Tjipannas (Preanger Reg.), beschrijving en scheikundig onderzoek van dien te Tjiradjas (Krawang).*
Indisch Magazijn, Tweede Twaalftal, no 1/2: 162–166.
Reprint of an article published in the Bataviaasche Courant of 15 Sept. 1821.

1845 – *Gedachten op eene reis door het zuidoostelijk gedeelte der Residentie Bantam.*
Indisch Magazijn, Tweede Twaalftal, no 3/4: 1–36.
Account of his experience on a trip through SE. Bantam in W. Java. Account of the Badui people. Reprint of an article published in 1822.

1845 – *Fragment uit een Dagboek gehouden op eene reis over Java. Bestijging van den berg Tjerimai, gewoonlijk genoemd Tjermé, in de Residentie Cheribon.*
Indisch Magazijn, Tweede Twaalftal, no 3/4: 102–116.
Report on an exploration of Mt Tjeremai, above Cheribon. Reprint of an article published in 1825.

1845 – *Over inlandsche middelen tegen diarrhoe.*
Indisch Magazijn, Tweede Twaalftal, no 3/4: 116.
Indigenous recipes against diarrhoea. Copied from the paper published in 1825.

1845 – *De patma van Noesa Kambangan.*
Indisch Magazijn, Tweede Twaalftal, no 3/4: 179–194 (in L).
Reprint of an article published in the Bataviaasche Courant of 9 & 23 March 1825, in which he described his finding of *Rafflesia* in Nusa Kambangan I. (S. Central Java) and claimed this to be the largest flower, superseding *Nelumbium*.

1846 – An article in the 'Handelsblad'.
In this article BLUME advised to hold expositions of colonial products from the East and West Indies in the Netherlands from time to time.

1849–1856 – *Museum botanicum Lugduno-Batavum sive stirpium exoticarum, novarum vel minus cognitarum ex vivis aut siccis brevis expositio et descriptio.* Leiden. 2 vols.
Appeared in dated parts each of 16 pp. In all, I: 396 pp., 60 fig.; II: 256 pp., 58 fig. The second volume was not finished and had no index.
For publication dates, see STAFLEU & COWAN, Taxonomic literature, ed. 2, 1 (1976) 240.
A most important work, being a scientific catalogue of the Rijksherbarium collections, hence containing descriptions and treatments of plants from all over the world.
An Index to volume 2 was prepared by C.G.G.J. VAN STEENIS & CHEW WEE LEK at the Rijksherbarium in 1974 (see Appendix C).

1850 – *Antwoord aan den Heer W.H. De Vriese.*
Alg. Konst- en Letterbode 1850-II: 99–109, 114–123. Repr. 34 pp. in L.
BLUME defends his criticism on the identity of *Lycopodium arboreum* and the reduction of *Pinus merkusii*, and the right of the Rijksherbarium to be the depository of collections made by civil servants.

1850 – *Opheldering van de inlichtingen van den Heer Fr. Junghuhn.*
Alg. Konst- en Letterbode 1850-II: 258–261, 274–279. Repr. 19 pp. in L.
On JUNGHUHN's collection and the right of the Rijksherbarium as the proper public depository of botanical collections.

1852 – Copy of a letter to J.G. BAUD, Minister of the Colonies, dated 14 March 1840, *'nopens de bereiding van thee uit koffie-bladeren, met aanbeveling tot het nemen van proeven in het groot op Java zelf.'*
Natuurk. Tijdschr. Ned. Indië 3: 122–126.
Proposal to prepare tea from coffee leaves and suggesting experiments with this on a large scale in Java.
There are two other entries on the subject in 1844 & 1845; see also Astrea 1 (1851) 256.

1855 – *Mélanges botaniques.* 8°. No 1, 1 Aug. 1855: 1–8; no 2, 1 Sept. 1855: 9–12. Facsimile in Taxon 35 (1986) 274–285.
Until June 1985 assumed not to have been published; see STAFLEU & COWAN, Taxonomic literature, ed. 2, 1 (1976) 241.
The new names *etc.* in the *Mélanges* were validated by WALPERS in his Annales 4 (1857) 642–644 and a rather large extract was published in Flora 41 (1858) 254–256.
L. VOGELENZANG, librarian of the Rijksherbarium, found in VESQUE's bibliography of J. DECAISNE (C: 1883) that the latter had a copy of the *Mélanges* in his library, now incorporated in the Bibliothèque Nationale at Paris. H. HEINE located another copy in the Bibliothèque Central of the Muséum d'Histoire Naturelle at Paris which had belonged to the library of A.TH. BRONGNIART. The original copy mentioned in Flora is still not located. It was probably dedicated to NEES VON ESENBECK.
The pamphlet was not for sale, but it was effectively published and at least two copies exist. Both Paris copies were autographed to BLUME's close friends. He may have sent more copies to other botanists with whom he was befriended. Obviously BLUME published it at his own expense and the reason for this is unknown. He could have published it in his *Museum Botanicum Lugdunum-Batavum.*
The first numéro of the *Mélanges* contains a discussion on paper-making by the Sino-

Japanese and three species are described of *Broussonetia* (2 new). Furthermore there is a section 'synonymie de quelques plantes peu connues', concerning species and genera of *Cunoniaceae, Saxifragaceae, Rosaceae, Guttiferae (Cratoxylon), Dipterocarpaceae, Ulmaceae, Moraceae*, and *Nepenthes*. Numéro 2 contains *Chrysobalanaceae* and *Rosaceae (Pygeum)* (B: van Steenis, 1986).

1858 – *Bijdrage tot de kennis der Oost-Indische Orchideën en het maaksel (de organisatie) van hare bevruchtingswerktuigen.*
Versl. & Meded. Kon. Ned. Akad. Wetensch., Amsterdam 7: 100–115, 2 pl.
Interpretation of the orchidaceous flower, with special regard to *Apostasiaceae.*

1858(–1859) – *Flora Javae et insularum adjacentium. Nova Series.* Leiden. pp. 8+6+162, 66 col. pl.
Also edited with a French title, see below.
A sumptuous work in which Blume summarized his large knowledge on orchids in which he had great insight since he wrote the *Bijdragen* (1825–1827).

1858(–1859) – *Collection des Orchidées les plus remarquables de l'Archipel Indien et du Japon.*
The French-titled version of the *Flora Javae, Nova Series.*
For publication dates, see Stafleu & Cowan, Taxonomic literature, ed. 2, 1 (1976) 240.

1859 – (with A.H. van der Boon Mesch) *Geschikte materialen uit de Overzeesche bezittingen voor het vervaardigen van papier.*
Report about useful materials from overseas territories suitable to manufacture paper.

1859 – *Vanda suaveolens Bl.*
Ann. Hort. Bot. ou Fl. Jard. Pays-Bas 2: 1–2, 1 col. pl.

1859 – *Over eenige Oost-Indische houtsoorten in verband met de verwoestingen door den paalworm of andere schelpdieren hier te lande en elders aangerigt.*
Versl. & Meded. Kon. Ned. Akad. Wetensch. 9: 25–49. Repr. 25 pp. in L.
A scholarly review of timbers resistant against teredo and other molluscs, in which Blume summarized experience onwards of Rumphius and collected data from all kinds of sources, indicating valuable species to be used in sea harbours.

1860 – *De houtteelt verbonden met den landbouw.*
Tijdschr. Ned. Mij. ter Bevordering van de Nijverheid 23: 1–29.
Cultivation of timber species in relation to agriculture.

1861 – *Monographie des Anoectochilus, Goodyera et genres voisins, les plus remarquables de l'archipel Indien et du Japon.*
Belg. Hort. 11: 369–378, 1 pl.
Extract from *Flora Javae, Nova Series* (1858–1859).

1863 – *Flora Javae. Planches inédites.*
23 coloured folio plates of Javanese plants with names and analyses. These were probably intended for further instalments of the *Flora Javae*, but remained without text.
On the back of some plates an advertisement was printed by a booksellers firm in Leiden; herein Blume's works were offered for sale, as a packet, probably one or two years after his death.
I have distributed a few copies to some herbaria, with a note, in November 1947 (C: 1947).
Further particulars I published in *Blumea* 6 (1948) 263.

Excluded

1823 (April) – *Herinnering aan acht merkwaardige dagen van mijn leven, op een uitstapje naar de top van de Gounong (berg) Gedu.*
This concerns a 16 pp. manuscript which has wrongly been attributed to Blume. It was written by a party following Blume's trail to the lower part of the crater of Mt Gedeh above Tjibodas. It is preserved in the library of the Instituut van Taal-, Land- en Volkenkunde, Leiden University (H 338).

Appendix B – Biographical sources

Aa, A.J. van der. 1878. Biographisch woordenboek der Nederlanden. Bijvoegsel: 34–35; *ibid.*: 111–115. – A concise biography.

Anonymous. 1827–1856. Algemeene Konst- en Letterbode 1827-II: 137; 1829-I: 227; 1831-I: 50, 359; 1833-I: 429; 1838-II: 290; 1851-I: 257; 1853-I: 193, 305; 1855: 118; 1856: 57.

Anonymous. 1853. Bonplandia 1: 228. – Blume was in Berlin and offered (obviously at a meeting) fibres of *Boehmeria tenacissima* Bl. which he said had a great durability and could possibly be of importance for the navy. He was then presented to the King of Prussia. On the fibres of this *Boehmeria* he published in the *Mélanges botaniques* (A, 1855).

Anonymous. 1855. Bonplandia 3: 155. – Here it was reported that Reinwardt sold his library for Dfl. 20,000. His herbarium was donated to the University herbarium of Leiden, on the condition that it should not be incorporated in the Rijksherbarium.
N.B. In the *'Instruction'* of 1832 (see C: van Dam) it had been officially decreed that the University herbarium was to be merged with the Rijksherbarium!

Anonymous. 1858. Flora 41: 254–256. – Extract review of *Mélanges botaniques*.

Anonymous. 1862. Leidsch Dagblad, 5 Febr. 1862, no 598. Repr. of 3 pp. in L. – Formal obituary.

Anonymous. 1862. Bonplandia 10: 47. – Obituary note.

Anonymous. 1862. Botanische Zeitung 20: 56. – Obituary note.

Anonymous. 1862. Proceedings Linnean Society of London 1862: xcvi–xcviii. – Obituary note.

Anonymous. 1862 or 1863. Annuaire de l'Académie de Paris. – Obituary note (not seen).

Anonymous. 1875. Allgemeine Deutsche Biographie 2: 746–747. – Short biography.

Anonymous. 1875. Album Studiosorum Lugdunum Batavum 1575–1875, column 1243. – Short biography.

Anonymous. 1930. Nieuw Nederlandsch Biographisch Woordenboek 8: 132–133. – Short biography.

Backer, C.A. 1936. Verklarend woordenboek van wetenschappelijke plantennamen: 70. – Brief biography.

Baillon, H.E. 1877. Dictionnaire de Botanique 1: 433.

Beumée, J.G.B. 1948. C.L. Blume, Museum Botanicum. Fl. Males. Bull. no 3: 69–70. – On the dates of publication.

Boerlage, J.G. 1896. Botanische literatuur. Encyclopaedie van Nederlandsch-Indië ed. 1, 1: 210, 272–273, 280.

Bretschneider, E. 1898. History of European botanical discoveries in China: 308–309. London. – Brief biography; Blume illustrated some Chinese plants.

Burdet, H.M. 1972. Cartulae ad botanicorum graphicem. Candollea 27: 327–328.

Candolle, A. de.1862. Mémoires et souvenirs de A.P. de Candolle: 150, 383, 412.

—— 1880. Phytographie: 318. – Praises the excellent figures in Blume's *Museum Botanicum.*

COLENBRANDER, H.T. 1926. Koloniale Geschiedenis 3: 111.

DANSER, B.H. 1938. Who can give further information about the dates of publication of Blume's Flora Javae? Chron. Bot. 4: 454–455.

—— 1939. The publication dates of Blume's Flora Javae. Blumea 3: 203–211.

GODDIJN, W.A. 1931. 's-Rijks Herbarium 1830–1930. Meded. Rijksherb. 62b: 1–53. – Rather extensive biographical notes.

GIJZEN, A. 1938. 's-Rijks Museum van Natuurlijke Historie, 1820–1915: 100–101. Rotterdam. – On BLUME's zoological contributions to the Leiden Museum.

HALL, H.C. VAN. 1862. C.L. Blume. De Nederl. Spectator, 22 Febr. 1862, no 8: 57–59. – Biographical data; rather extensive (in L).

HASSKARL, J.K. 1850. Antwoord aan den heer C.L. Blume, wegens onderscheidene te mijnen aanzien geuite beschuldigingen, vervat in zijn antwoord aan den heer W.H. de Vriese, Leiden 1850. Alg. Konst- en Letterbode 1850. Repr. of 16 pp. in L. – HASSKARL defending his rights to have a private herbarium.

JACOBS, M. 1980. C.L. Blume (1796–1862). Fl. Males. Bull. no 33: 3362–3363.

JANSEN, P. & W.H. WACHTER. 1941. Ned. Kruidk. Arch. 51: 343. – Biographical references.

JUNGHUHN, F. 1837. Brief aan C.L. Blume vanuit Djocjakarta, 2 Febr. 1837. Alg. Konst- en Letterbode 1837-II: 275–277.

—— 1850. Inlichtingen aangeboden aan het publiek over zeker geschrift van den heer C.L. Blume, en antwoord aan dien Heer. Alg. Konst- en Letterbode 1850, no 41. Repr. 9 pp. in L. – Self-defense in keeping his private herbarium.

—— 1850. Vervolg der inlichtingen aangeboden aan het publiek over een geschrift van den heer C.L. Blume. Alg. Konst- en Letterbode 1850. Repr. 29 pp. in L. – Polemics with BLUME.

—— 1851. Een woord over den Sambinoer-boom van Sumatra, betrekkelijk deszelfs botanische bepaling. Ned. Kruidk. Arch. 2: 2–16. – On BLUME's reduction of JUNGHUHN's *Lycopodium arboreum* to *Dacrydium*.

—— 1853. Java, zijne gedaante, zijn plantentooi, en inwendige bouw, 1: 183–186. 2nd Dutch ed.

KALKMAN, C. 1979. The Rijksherbarium, past and present. Blumea 25: 13–26, especially p. 14.

KOSTER, J.Th. Facsimile handwritings of BLUME. – Unpublished (in L).

LASÈGUE, A. 1845. Musée botanique de M. Benjamin Delessert: 268, 293, 307, 315, 346, 347, 506, 535, 562.

LEENHOUTS, P.W. 1980. Het Botanisch Kabinet te Franeker: 34.

LINTUM, C. TE. 1913. Een eeuw van vooruitgang, 1813–1913. Zwolle (not seen). – BLUME was far ahead of his time in having found the solution of the combat against cholera by the simple boiling of drinking-water.

MACLEAN, J. 1979. Carl Ludwig Blume and the Netherlands East Indies. Janus 66: 15–29. – Period 1820–1831; valuable biographical essay. MACLEAN traced many letters in the Colonial Archives of the 'Rijksarchief', The Hague.

MIQUEL, F.A.W. 1856. Review of Blume, Museum Botanicum. Bot. Zeit. 14: 185–188, 540–541. – MIQUEL complained severely about BLUME's antedating issues of the *Museum Botanicum* and his attempts to withhold information from his colleagues.

OUDEN, A. DEN. 1979. C.L. Blume, periode 1826–1832. Unpublished essay, made under supervision of Dr. P. SMIT, Biohistorical Institute, Utrecht. – A thorough account, largely based on official letters and documents of the period mentioned, as present in the 'Rijksarchief', The Hague.

PRITZEL, G.A. 1872. Thesaurus literaturae botanicae: 29. – BLUME's selected bibliography.

PULLE, A.A. 1917. Botanische literatuur. Encyclopaedie van Nederlandsch Indië ed. 2, vol. 1: 317, 394–395; *ibid.* 1919. Vol. 4: 422.

RAALTEN, G. VAN. 1825. Unpublished letter to J.G.S. van Breda (?). – Erroneous accusation that BLUME stole property or information from KUHL & VAN HASSELT (in L).

ROLAND, M. 1944. Alfred Moquin-Tandon. Un naturaliste à Paris sous Louis-Philippe. Journal d'un voyage inédit (1834). Paris, Mercure de France ed. 3: 351 pp. – Historically a most interesting booklet full of biographical data of French botanists. BLUME paid a prolonged stay to Paris in Sept./Oct. 1834.

RÖMER, L.S.A.M. VON. 1921. Historische Schetsen. Batavia. 335 pp., 109 pl.; a very brief obituary on p. 193. – It is most peculiar that in the brief history of cholera (pp. 232–238) the author, himself a physician, makes no mention at all of BLUME's important work on the subject.

SCHOUTE, D. 1937. Occidental therapeutics in the Netherlands East Indies during three centuries of Netherlands settlement. Publication of the Netherlands Indies Health Service: 114–119. – Cited the governmental regulations and instructions for the native chiefs, extension of the vaccination, *etc.* Some of these might have actually been written by BLUME, who was chief of vaccination and later even chief of the medical service.

SEEMANN, B. 1863. Journ. Bot. 1: 64. – Short obituary.

SEEMANN, W.E.G. 1859. Bonplandia 7: 52–53. – BLUME complained that the Netherlands Government did not contribute funds towards the publication of the *Flora Javae, Nova Series*, and that this was printed at his own expense. SEEMANN had received the volume, or at least first sheets of it, on 3 Nov. 1858. He criticizes BLUME for having given too little attention to the works of LINDLEY and REICHENBACH.

SIRKS, M.J. 1915. Indisch Natuuronderzoek: 109–112, portr. Amsterdam. – Brief biographical notes.

SMIT, P. 1979. The Rijksherbarium and the scientific and social conditions which influenced its foundation. Blumea 25: 5–11. – In this excellent essay on the foundation of the Rijksherbarium SMIT erroneously mentioned (p. 9) that BLUME transferred the KUHL & VAN HASSELT specimens to Leiden in 1826.

—— & R.J.CH.V. TER LAAGE (eds.). 1970. Essays in biohistory. Regnum Vegetabile 71.

STAFLEU, F.A. 1966. Wentia 16: 28–31. – In an excellent biography of MIQUEL some notes on BLUME.

—— 1970. The Miquel-Schlechtendal correspondence. A picture of European botany, 1836–1866. In: P. SMIT & R.J.CH.V. TER LAAGE, Essays in biohistory. Regnum Vegetabile 71: 295–341. – Many data on BLUME and his works. Page 307: DECAISNE made several drawings for *Rumphia*. Page 324: JUNGHUHN sold his herbarium to the University of Leiden on the condition that it should not be incorporated in the Rijksherbarium. Page 326: Reference to MIQUEL, who was glad that in February 1851 a new, more 'liberal' Instruction for the Rijksherbarium was issued by the Government. Page 331: Reference to MIQUEL's complaint about the irregularities with the dates of *Museum Botanicum*. Page 334: Reference to the difficulty in choice of a successor of BLUME.

—— 1978. Flora Malesiana I, 8: (7)–(16). – Dedication to the memory of F.A.W. MIQUEL, containing some notes on BLUME.

—— & R.S. COWAN. 1976. Taxonomic literature. Ed. 2, vol. 1: 234–241 (Regnum Vegetabile 94).

STEENIS, C.G.G.J. VAN. 1941. Natuurwet. Tijdschr. Ned. Ind. 101: 216. – The *Planches inédites* appeared at least before 1883.

—— 1948. On the date of publication of Blume's Planches inédites. Blumea 6: 263.

—— 1979. The Rijksherbarium and its contribution to the knowledge of the tropical Asiatic flora. Blumea 25: 57–77, especially pp. 60–62. – BLUME's endeavours.

—— 1980. The publication of Blume's Tabellen en Platen voor de Javaansche Orchideeën. Miscellaneous Papers Landbouwhogeschool, Wageningen 19: 289–291.

—— 1986. Blume's Mélanges botaniques effectively published, 1855. Taxon 35: 272–273; facsimile of the *Mélanges*: 274–285.

—— & M.J. VAN STEENIS-KRUSEMAN. 1970. The plates of Javanese plants of Francisco Noroña, with a revised evaluation of his generic names. In: P. SMIT & R.J.CH.V. TER LAAGE: Essays in biohistory. Regnum Vegetabile 71: 353. – BLUME has seen NOROÑA's plates in Java, as well as

Reinwardt. Incidentally Blume mentioned a few Noroña names in the synonymy of his works.

Steenis-Kruseman, M.J. van. 1950. Carl Ludwig Blume. Flora Malesiana I, 1: 64–66, 600, portr. – Brief personalia; account of Blume's travels and publications.

—— 1979. Directorate of C.L. Blume. Blumea 25: 35–39.

Treub, M. 1889. Geschiedenis van 's-Lands Plantentuin te Buitenzorg. Meded. 's Lands Plantentuin 6: 1–79. Batavia. – History of the Botanic Gardens, Bogor, from 1817 till 1844.

—— 1892. Korte geschiedenis van 's-Lands Plantentuin te Buitenzorg: 7–9, portr. – Short history, as above.

Ule, Witty. Geschichte der Kaiserlichen Leopoldinisch-Carolinischen Akademie der Naturforscher 1852–1882. No. 1071 (not seen).

Veth, P.J. 1884. Ontdekkers en onderzoekers: 45–149. Leiden. – Mostly on Reinwardt; portrait of Blume.

Vos, C. de. 1888. Korte schets van de geschiedenis der plantkunde *etc.*: 91–92. Bolsward.

Vriese, W.H. de. 1851. Naschrift (to Junghuhn's paper). Ned. Kruidk. Arch. 2: 13–17 (in L). – Defending Junghuhn.

—— 1851. Teregtwijzing van C.L. Blume's naamsverwarring. Alg. Konst- en Letterbode 1850-II: 35–38. Repr. of 4 pp. in L. – On the reduction of *Pinus merkusii* to *P. finlaysoniana*.

Weigel, T.O. 1863 (Jan.). Verzeichniss der nachgelassenen Bibliothek von C.L. Blume. Leipzig. III–VI + 81 pp. – With portrait of Blume.

Winkler-Prins, C. 1949. Encyclopaedie ed. 6, 4: 374.

Wit, H.C.D. de. 1949. 47. Blume. Flora Malesiana I, 4: civ–cv. – A brief account of Blume's life; discussion of achievements and main publications.

—— 1950. History of Malesian botany. 29 pp., unpublished. – Typed copies of letters to and from Blume, partly relating to herbarium Reinwardt, but largely official letters on the sale and distribution of *Flora Javae* and *Rumphia*. Several derived from the 'Rijksarchief', The Hague.

Zollinger, H. 1841. Tagebuch (ined.), 5 Oct.–31 Dec. – Unpublished diary of Zollinger; typed copy by H. Wanner in L.

Appendix C – References to cited literature

Arckenhausen, J.C.P. See his biography by H.-G. Griep *et al., vide infra.*

Breda, J.G.S. van. 1827–1829. Genera et species Orchidearum et Asclepiadarum quas in itinerere per insulam Java collegerunt Dr. H. Kuhl et Dr. J.C. van Hasselt. Ghent. Folio. 15 fol. & 15 tab. col.

Dam, van. 13 Febr. 1832. Ontwerp van eene instructie voor den Directeur van het Rijksherbarium (Ministry of the Interior, 5th Div., No. 254 – Concept of an Instruction to the Director of the Rijksherbarium).

Directions for the director in 14 articles: how to manage the collections, the accommodation, the facilities for and availability to other botanists, loans, the making of a catalogue of the collections, exchange of duplicates, desirability of acquiring collections from civil servants, the fusion of the University Herbarium with that of the Rijksherbarium, the order that the director writes an annual report on the important accessions, and that proposals of the director had to go via the Curators of the University.

A particularly ticklish point was stipulated in art. 10, in which the director was prohibited to publish on discoveries of still living persons and explorers without their consent.

The Instruction was approved by the Minister of the Interior and was stipulated to be effective from January 1st, 1831.

Griep, H.-G., H. Ullrich & G. Wagenitz. 1977. Johann Christian Arckenhausen (1784–1855). In H. Ulrich (ed.), Goslarer Künstler und Kunsthandwerker 1: 1–32, illust. (D, 12).
Hall, H.C. van. 1856. Voorstel omtrent de voortzetting van de uitgave der Flora Javae. In W.H. de Vriese: Tuinbouwflora 3: 365–366.
Hennipman, E. 1979. The collections of Pteridophytes at the Rijksherbarium. Blumea 25: 103–106.
Reinwardt, C.G.C. 1826. Nova plantarum indicarum genera. Syll. Plant. Ratisb. 2: 1–15.
—— 1828. Ueber den Charakter der Vegetation auf den Inseln des Indischen Archipels. Ein Vortrag. Kön. Akad. Wiss. Berlin: 1–18.
Steenis, C.G.G.J. van. 1947. Introduction to the Planches inédites Flora Javae (mimeographed). – Pamphlet, consisting of a coloured folio plate of Blume's *Planches inédites* with at the back an advertisement for the sale of Blume's works, probably from 1862 or 1863. Copies were sent to some selected European libraries.
—— & Chew Wee Lek. 1974. Index to C.L. Blume, Museum Botanicum Lugduno-Batavum, vol. 2, 1856–1857. Leiden. 24 pp.
—— , M.J. van Steenis-Kruseman & C.A. Backer. 1954. Louis Auguste Deschamps. Bull. Brit. Mus. Nat. Hist., Hist. ser. 1, no 2: 51–68, pl. 13 (a reproduction of the drawing Deschamps made of *Rafflesia*).
Steenis-Kruseman, M.J. van. 1950. Kollmann's collection of Javan plants. Bull. Jard. Bot. Btzg sér. III, 18: 463–466.
—— 1962. Contributions to the history of botany and exploration in Malaysia. 8. Heinrich Bürger (?1806–1858), explorer in Japan and Sumatra. 9. The transfer of the Rijksherbarium from Brussels to Holland in 1830. Blumea 11: 495–505; 505–508, 1 photo.
—— 1979. The collections of the Rijksherbarium. Blumea 25: 29–56.
Thorbecke, J.R. 11 Nov. 1850. Instructie voor den Directeur van het Rijks-Herbarium te Leijden (Ministry of the Interior, 5th Div., No. 254 – Instruction for the Director of the Rijksherbarium at Leijden). 22 pp. (in L).
Instruction to replace that of 1832 (see under C: van Dam), consisting of 28 articles. New stipulations were: the director should be present on the first three days of the week; not more than one family of plants can be borrowed by a single person; the director is prohibited to use data from the still living members of the former 'Natuurkundige Commissie' without their permission; he is not allowed to have a private collection; as to exchange, priority has to be given to Dutch botanists and institutes, effective onwards of December 1st, 1850.
A most peculiar stipulation was in art. 18: anybody could claim to receive duplicates from the overseas territories (the names of which had already been printed and the plants described) even when nothing was offered in exchange. So it has happened recently that, in cleaning a school somewhere in Holland, a set of Javanese sheets was found, obviously claimed by a former enthusiastic teacher who had, it seems, no employ for it.
Vesque, J. 1883. Catalogue de la Bibliothèque de feu M. J. Decaisne. Avec une notice biographique par M. le Dr. Ed. Bornet. Paris. Libraire de la Bibliothèque Nationale: 13. – Listing under no 56: 'Blume, Mélanges botaniques (Premier et deuxième numéro). Leyde, 1855, br. in-8, de 12 pp.–Envoi autogr. de l'auteur à M. Decaisne.
Vriese, W.H. de. 1858. Reinwardt's Reize naar het Oostelijk gedeelte van den Indischen Archipel in het jaar 1821 *etc.* Amsterdam.

Appendix D – Notes

1)–Later it was said that Blume misused the collections and manuscripts of A. Zippelius, a gardener of the Botanic Gardens at Buitenzorg (Bogor), who made a long exploration trip to the Moluccas, SW. New Guinea, and Timor, where he died.

Surely ZIPPELIUS made a most important collection, but he left no manuscripts at L; we only have a box full of old provisional labels. As a matter of fact, P. BLEEKER found in the archives of the 'Natuurkundige Vereeniging' at Batavia manuscripts and notes of ZIPPELIUS that were offered to BLUME about 1850, under the condition that the latter should publish them. BLUME never replied to this. In fact this request came two decades too late, as BLUME had worked on ZIPPELIUS's material (received through the intermediary of J.B. SPANOGHE IN ± 1830/31) and published this earlier in *Rumphia* and in the *Museum Botanicum*. BLUME honoured ZIPPELIUS by naming the Piperaceous genus *Zippelia* after him. (See also the footnote under D: 4.)

BLUME has also been accused of having left at Bogor no duplicate specimens of the collections he took to the Netherlands, but this is untrue (see C: VAN STEENIS-KRUSEMAN, 1950; and D: 4).

As to the KUHL & VAN HASSELT collections: they did not add many novelties to what BLUME himself had collected. The sites where he travelled covered most of theirs, and even far beyond eastwards. Besides, the KUHL & VAN HASSELT collections came only in BLUME's hands in 1828 when he had already published his *Bijdragen* (1825–1827) and *Enumeratio* (1827–1828). And as late as 1844 VAN BREDA offered him a packet of notes written by KUHL and VAN HASSELT, when the main part of *Flora Javae* (1828–1851) had already been published.

2) – PH.F. VON SIEBOLD, a most meritorious scientist, withheld his collections from BLUME. Most of VON SIEBOLD's botanical collections were not made by himself, but by BÜRGER, TEXTOR, KEISKE and others (see C: VAN STEENIS-KRUSEMAN, 1962). VON SIEBOLD also was a dominating, ambitious person. The *Flora Japonica* was authored by 'SIEBOLD & ZUCCARINI', but the latter, professor at Munich, was the proper author responsible for the research. VON SIEBOLD hardly had any claim towards being a botanical taxonomist. As BÜRGER belonged to the 'Natuurkundige Commissie', their herbarium should properly go to the Rijksherbarium. Though BÜRGER's share in the undertaking was very large – he also wrote a large manuscript on Japanese fishes – VON SIEBOLD later refused to support BÜRGER's second appointment to the 'Natuurkundige Commissie' for the exploration of W. Sumatra, because the latter would not be sufficiently endorsed with scientific knowledge (*l.c.* 501), a most ungracious and unjust gesture.

VON SIEBOLD claimed later to have been the saviour of the Rijksherbarium in 1830, whereas his sole purpose was to get back specimens collected during his internment by the Japanese in Deshima (*l.c.* 501). Whatever the great merits of VON SIEBOLD may have been, these facts throw a distinct shadow on his honesty and tolerance regarding other people.

3) – F.W. JUNGHUHN was a physician of the army since 1835, but his superior, A.E. FRITZE, permitted him to devote himself to the study of nature. In 1840 he was charged with making investigations in the Batak Lands, W. Sumatra. After his return to Java JUNGHUHN was appointed a member of the 'Natuurkundige Commissie' (1845–1848). Through his *Reisen durch Java* and *Die Battaländer auf Sumatra* it became clear that JUNGHUHN had amassed a great herbarium, and BLUME claimed this for the Rijksherbarium. JUNGHUHN refused, which caused BLUME's irritation. As JUNGHUHN was no taxonomist and had made errors in precursory papers (amongst others with *Lycopodium arboreum*), BLUME's sharp remarks on this led to a strong mutual animosity between him and JUNGHUHN.

4) – According to my wife (C: VAN STEENIS-KRUSEMAN, 1950), G.H.J. KOLLMANN was a German senior physician, in the service of the Dutch East Indian army and stationed at Buitenzorg (Bogor) in 1821–1835, on leave in Europe in 1835–1837. In 1837 he offered the Dutch government a collection of Javanese plants for sale.[1] His letter and material were designated to BLUME, who, to

(1) About the contents of the collection which came in Kollmann's hands more can be found in J. MACLEAN, Scientiarum Historia 15 (2), 1973, 112–113. They comprised zoological collections as well as ethnographical ones besides the herbarium specimens. According to KOLLMANN they were acquired at auctions (presumably in Java) and contained not only BLUME collections but also ZIPPELIUS plants (M.J. VAN STEENIS-KRUSEMAN).

his surprise, found that this was the set of duplicates (more than 4000) of his collection he painstakingly left at Buitenzorg when returning to Holland. Kollmann himself never collected. Obviously the collection had been stored somewhere in the annexes of the Palace at Buitenzorg, adjoining the Botanic Gardens. The curator of the Gardens, James Hooper, was subordinated to the Intendant of the Palace. In some way or other Kollmann appropriated this collection. The rumour that Blume did not leave duplicates at Buitenzorg appears fully untrue. Why he never alluded in print to the curious way in which the Bogor duplicate collection came into his hands, can only be guessed at (D: 14). He was either loyal to Kollmann, with whom he had friendly relations, or he found it unnecessary to justify himself. Anyway it shows his loyalty to the Buitenzorg Gardens.

5) – Both J. Maclean and A. den Ouden (B: 1979) have searched in the 'Rijksarchief', The Hague, where all official correspondence by Blume is kept. For a proper biography the period 1830–1862 should also be covered. Moreover, personal letters will be kept in the archives of several botanical institutes as Blume had contacts with many botanists.

6) – It is quite possible that, as soon as Blume had finished the text for a fascicle of *Museum Botanicum*, he sent it to the printers and assumed it then to be effectively published. In his splendid isolation, surrounded by envious, hostile colleagues and antagonists, Blume did not care about their interests. Leiden was at that time a centre where nobody did care about collaboration or sympathy, each staff member promoting self-interests; a most unfortunate situation.

7) – The number of extensive biographies of prominent Dutch botanists is small. I know off-hand only those of C.G.C. Reinwardt, Hugo de Vries, W. Beijerinck, F. Junghuhn, J.P. Lotsy, F.A.W. Miquel, and H.J. Lam. Such biographical studies require much time, and also historical-minded people to compose them. If one should like to have a posthumous biography made, it is best, in my opinion, to write an autobiography; one ought to think timely of this.

8) – The diary of H. Zollinger contains notes on his stay at Leiden in 1841, with interesting personal information on members of the biological circle at Leiden. Amongst others about the complaints of Reinwardt that Blume did not give him sufficient honour and published all novelties under his own name. But C.A.L.M. Schwaner, a German geologist and member of the 'Natuurkundige Commissie', said that this was due to the fact that Reinwardt did not publish himself, even not his own report on the exploration in East Malesia, and that Reinwardt's reasons for not publishing was that he was afraid not to come up to the expectations the botanical public had of him. As a matter of fact, the lecture Reinwardt held for this select public, the 'Versammlung Deutsche Naturforscher und Aerzte' on 20 September 1828 about the vegetation of Malesia, was not exciting, but mediocre (C: Reinwardt, 1828). The same holds for his paper *Nova plantarum indicarum genera*; many genera were assigned to wrong families and several others had been described before. Reinwardt's creative efforts lay mainly in the organization of botany and cultures in Java, not in research. His report on the exploration of the Moluccas was after his death published in 1858 by W.H. de Vriese (C: 1858), together with a biography.

Another fact Zollinger mentioned was that it was not due to Blume that P. Korthals abandoned botany. Korthals told Zollinger at the time the first was working out his most important, meticulous observations, that botany was an inferior branch of science as compared with philosophical and etymological studies, which he found more interesting and scholarly.

9) – According to Weigel's catalogue (B: Weigel, 1863), Blume had a very large library, the total number of entries being 2123, largely concerning botany (1527 entries). It is peculiar that Blume's works are only represented by 9 items. None of his publications on useful and medicinal plants were represented.

10) – As a matter of fact, the majority of biologists, physicians, and explorers in the early part of last century concerned with the biology of the Indies were scientists with the German nationality or of German descent, *e.g.*, ARCKENHAUSEN, BLUME, BÜRGER, J.B. FISCHER, HASSKARL, JUNGHUHN, KUHL, MACKLOT, SAL. MÜLLER, REINWARDT, VON ROSENBERG, SCHLEGEL, SCHWANER, VON SIEBOLD, ZIPPELIUS. Also in South American and African botanical pioneer exploration Germans played a prominent role in the former century.

11) – As to his health, BLUME withstood illnesses obviously rather well, probably because he applied his own devices, drinking boiled water, *etc.* He was reported to suffer of fever during his trip to Rembang (see A: 1828). In 1826 (Java) BLUME complained of illness. In Holland he was rather seriously ill about 1829. Early 1850 he suffered of laryngitis.

12) – H.-C. GRIEP *c.s.* (C: 1977) in their biography of J.C.P. ARCKENHAUSEN reproduced a letter (in the 'Rijksarchief', The Hague) from BLUME to the Minister of the Interior at The Hague (d.d. 27 Dec. 1832), in which he pleads for the second time for a permanent position of ARCKENHAUSEN. BLUME mentioned that he had 1500 drawings, mostly from LATOUR, made in Java. These drawings were sketches which should be made ready for reproduction in *Flora Javae* and often needed to be supplemented by details (from herbarium material). ARCKENHAUSEN could manage to prepare 7 or 8 drawings monthly. As the publication of *Flora Javae* at Brussels needed monthly 12 drawings for the two instalments, BLUME had attracted a certain Mr. VIVIEN as draughtsman (in 1827) and Mr. SIXTUS (in 1828) for keeping pace. VIVIEN disappeared in 1829 and he was replaced by ARCKENHAUSEN. The Minister was of the opinion that ARCKENHAUSEN should be paid from the *Flora Javae* project funds. The latter worked for BLUME at least until 1832, possibly longer. After repatriation to Germany ARCKENHAUSEN remained draughtsman in Goslar, drawing all kinds of plants and animals, mostly for KREBS, *Naturgeschichte.* After ARCKENHAUSEN's death (1855) his estate was sold in 1862, among which 134 plates of *Flora Javae.* In the library of the Naturwissenschaftliche Verein, in volume 19 (portfolio), 190 plates of BLUME's work are preserved, of which some unfinished sketches. Whether they are originals or printed copies, and whether there are unpublished drawings among them, has still to be examined. Plates by ARCKENHAUSEN are reproduced too in *Rumphia*, volumes 1–3.

In Java J.TH. BIK was another artist, originally in the service of REINWARDT, who drew for BLUME.

13) – Why the polemic papers between BLUME and JUNGHUHN, DE VRIESE, and others (see B) started as late as 1850 is unclear, because BLUME had already in 1844 (see A) reduced *Lycopodium arboreum* – the subject of controversy. BLUME's denigrating words accompanying the reduction were published by him in *Rumphia* (3: 219, 221) and these gave offence to JUNGHUHN and DE VRIESE. STAFLEU & COWAN (Taxonomic literature, ed. 2, vol. 1, 1976) gave 1847 as date for this part of *Rumphia*, but it might be that 1849 fits better (as mentioned by LORENTZ, *cf.* Flora Malesiana I, 4: clxxii, and also accepted by DE WIT).

14) – Why BLUME did not defend himself more openly and publicly is not clear. It is of course a fact that one cannot well oppose rumours without published evidence. He was clearly not a very militant personality. BLUME took action only twice: first, when he revealed the transfer of the Rijksherbarium from Brussels and gave honour to FISCHER (A: 1831); and second, in defending himself against JUNGHUHN (A: 1850). For the rest he satisfied himself by writing explanatory letters. Though convinced of his view on the cause of cholera, he did not officially oppose MULDER in public. In all these matters I am inclined to believe BLUME felt it below his dignity to expose himself.

Appendix E – Eponymy

Blumia C.G.D. Nees 1823, *nom. rejic.* (= *Magnolia* L.).
Blumia K.P.J. Sprengel 1826 (= *Saurauia* Willd.).
Blumea H.G.L. Reichb. 1828 (= *Neesia* Blume).
Blumea A.P. DC. 1833.
Blumeodendron Kurz 1873.
Blumella van Tieghem 1895 (= *Elytranthe* Blume + *Macrosolen* Blume).
Blumeopsis Gagnep. 1920.

The journal *Blumea*, official botanical journal of the Rijksherbarium; vol. 1, 1934–*hodie.*

Epithets for species, *blumei, blumii, etc.*, are too numerous to enumerate here.

Appendix F – Honorary distinctions and memberships

1829 (31 March): Ridder (Knight) in de Orde van de Nederlandse Leeuw; the Netherlands.
1851: Légion d'Honneur; France.
1851: Preussische Rothe Adler-Ordens, 3. Klasse; Prussia.
1853: Knight Cross of the Albrechts Order of Sachsen; Saxony.
1853: Large golden medal for merits from the King of Belgium.

1822: Council member Bataviaasch Genootschap van Kunsten en Wetenschappen, Batavia; Netherlands Indies.
1825 (6 Febr.): Corresponding member of the Maatschappij van Landbouw en Kruidkunde; the Netherlands.
1827: Member of the Koninklijk Instituut van Wetenschappen, Letterkunde en Schoone Kunsten (the later Netherlands Royal Academy); the Netherlands.
1827 (29 June): Member of the Provinciaals Utrechtsch Genootschap voor Kunsten en Wetenschappen, Utrecht; the Netherlands.
1829 (7 Jan.): Member of the Königliche Botanische Gesellschaft zu Regensburg; Bavaria, Germany.
1833: Member of the Hollandsche Maatschappij van Wetenschappen, Haarlem; the Netherlands.
1845: Doctor honoris causa and Matheseos magister of Leiden University; the Netherlands.
1851 (7 April): Foreign corresponding member of the Institut de France, Paris; France.
1853 (May): Ordinary member of the Kaiserliche Akademie für Naturkunde, Moscow; Russia.
1855: Honorary member of the 'Maatschappij ter Bevordering der Geneeskunde', Baden; Germany.
1855 (31 March): Member of the Koninklijke Akademie van Wetenschappen, Amsterdam; the Netherlands.
1856 (10 Oct.): Member of the Royal Academy of Sciences, Stockholm; Sweden.

Member of:
Caesarea Leopoldino-Carolina Academia Naturae Curiosorum, Bonn; Germany. *Cognomen: Rumphius secundus.*
Linnean Society of London; England.
Societas Caesarea Naturae Curiosorum Mosquensis, Moscow; Russia.
Societas Medico-Botanica Londinensis, London; England.
Natuurkundige Vereeniging van Nederlandsch-Indië, Batavia; Netherlands Indies.

ABBREVIATIONS AND SIGNS

acc. = according
Ak. Bis. = Aklan Bisáya (Philip. language)
Alf. Cel. = Alfurese Celebes (language)
alt. = altitude
Anat. = Anatomy
Ap. = Apáyao (Philip. language)
app. = appendix, appendices
appr. = approximate
Apr. = April
Arch. = Archipelago
atl. = atlas
auct. div. = *auctores diversi*; various authors
auct(t). mal. = *auctores malayenses*; authors dealing with Malesian flora
auct(t). plur. = *auctores plures*; several authors
Aug. = August
Bag. = Bagóbó (Philip. language)
basionym = original name of the type specimen; its epithet remains permanently attached to the taxon which is typified by it provided it is of the same rank.
Bg. = Buginese (language)
Bik. = Bikol (Philip. language)
Bil. = Bilá-an (Philip. language)
Bill. = Billiton
Bis. = Bisáya (Philip. language)
Bon. = Bontók (Philip. language)
Born. = Borneo
Bt = Bukit; mountain
Bug. = Buginese (language)
Buk. = Bukidnon (Philip. language)
c. = *circiter*; about
C. Bis. = Cebu Bisáya (Philip. language)
cf. = *confer*; compare
Chab. = Chabecáno (Philip. language)
citations = see references
cm = centimetre
c.n. = see *comb. nov.*
comb. nov. = *combinatio nova*; new combination
CS = cross-section or transversal section of an organ
c.s. = *cum suis*; with collaboration
cum fig. = including the figure
cur. = *curante*; edited by
D (after a vernacular name) = Dutch
Daj. = Dyak (language)
d.b.h. = diameter at breast height
D.E.I. = Dutch East Indies
descr. added behind a reference = means that this contains a valid description
diam. = diameter
Distr. (as an item) = Distribution
Distr. (with a geographical name) = District
ditto = the same, see *do*
Div. = Division, or Divide
div. = *diversus* (masc.); various
do = *ditto* (Ital.); the same
Dum. = Dumágat (Philip. language)
dupl. = duplicate
E = east (after degrees: eastern longitude)
E (after a vernacular name) = English
Ecol. = Ecology
ed. = edited; edition; editor
e.g. = *exempli gratia*; for example
elab. = *elaboravit*; revised
em(end). = *emendavit*; emended
em(erg). ed. = emergency edition
Engl. = English
etc., &c. = *et cetera;* and (the) other things
ex auct. = *ex auctores*; according to authors
excl. = *exclusus* (masc.); excluding, exclusive of
ex descr. = known to the author only from the description
f. (before a plant name) = *forma*; form
f. (after a personal name) = *filius*; the son
f. (in citations) = figure
fam. = family
Feb(r). = February
fide = according to
fig. = figure
fl. = *flore, floret (floruit)*; (with) flower, flowering
For. Serv. = Forest Service
fr. = *fructu, fructescit*; (with) fruit, fruiting
Fr. (after a vernacular name) = French
G. = Gunung (Malay); mountain
Gad. = Gaddáng (Philip. language)
gen. = *genus*; genus
genus delendum = genus to be rejected
Germ. = German
geront. = Old World
haud = not, not at all
holotype = the specimen on which the original description was actually based or so designated by the original author
homonym = a name which duplicates the name of an earlier described taxon (of the same rank) but which is based on a different type species or type specimen; all later homonyms are nomenclaturally illegitimate, unless conserved
I. = Island
ib(id). = *ibidem*; the same, in the same place
Ibn. = Ibanág (Philip. language)
ic. = *icon, icones*; plate, plates
ic. inedit. = *icon ineditum, icones inedita*; inedited plate(s)
id. = *idem*; the same
i.e. = *id est*; that is
If. = Ifugáo (Philip. language)
Ig. = Igorot (Philip. language)
Ilg. = Ilongót (Philip. language)
Ilk. = Ilóko (Philip. language)
in adnot. = *in adnotatione*; in note, in annotation
incl. = *inclusus* (masc.); including, inclusive(ly)
indet. = indetermined
Indr. = Indragiri (in Central Sumatra)
inedit. = *ineditus* (masc.); inedited
in herb. = *in herbario*; in the herbarium
in litt. = *in litteris*; communicated by letter
in sched. = *in schedula*; on a herbarium sheet
in sicc. = *in sicco*; in a dried state
in syn. = *in synonymis*; in synonymy
Is. = Islands
Is. (after a vernacular name) = Isinái (Philip. language)
Ism. = Isámal (Philip. language)
isotype = a duplicate of the holotype; in arboreous plants isotypes have often been collected from a single tree, shrub, or liana from which the holotype was also derived
Iv. = Ivatán (Philip. language)
J(av). = Javanese (language)
Jan. = January
Jr = Junior
Klg. = Kalinga (Philip. language)
Kul. = Kuláman (Philip. language)
Kuy. = Kuyónon (Philip. language)
Lamp. = Lampong Districts (in S. Sumatra)

Lan. = Lánao (Philip. language)
lang. = language
l.c. = *loco citato*; compare reference
lectotype = the specimen selected *a posteriori* from the authentic elements on which the taxon was based when no holotype was designated or when the holotype is lost
livr. = livraison, part
ll.cc. = *l.c.* (plur.)
LS = longitudinal or lengthwise section of an organ
m = metre
M = Malay (language)
Mag. = Magindanáo (Philip. language)
Mak. = Makassar, Macassar (in SW. Celebes)
Mal. = Malay(an)
Mal. Pen. = Malay Peninsula
Mand. = Mandáya (Philip. language)
Mang. = Mangyán (Philip. language)
Mar. = March
Mbo = Manóbo (Philip. language)
Md. = Madurese (language)
Minangk. = Minangkabau (a Sumatran language)
min. part. = *pro minore parte*; for the smaller part
mm = milimetre
Mng. = Mangguángan (Philip. language)
Morph. = Morphology
ms(c), MS(S) = manuscript(s)
Mt(s) = Mount(ains)
n. = *numero*; number
N = North (after degrees: northern latitude); or New (*e.g.* in N. Guinea)
NE. = northeast
nec = not
neerl. = Netherlands, Netherlands edition
Neg. = Negrito (Philip. language)
N.E.I. = Netherlands East Indies
neotype = the specimen designated to serve as nomenclatural type when no authentic specimens have existed or when they have been lost; a neotype retains its status as the new type as long as no authentic elements are recovered and as long as it can be shown to be satisfactory in accordance with the original description or figure of the taxon
N.G. = New Guinea
N.I. = Netherlands Indies
no = *numero*; number
nom. = *nomen*; name (only) = *nomen nudum*
nom. al. = *nomen aliorum*; name used by other authors
nom. alt(ern). = *nomen alternativum*; alternative name
nom. cons(erv). = *nomen conservandum, nomina conservanda*; generic name(s) conserved by the International Rules of Botanical Nomenclature
nom. fam. cons. = *nomen familiarum conservandum*; conserved family name
nom. gen. cons. = see *nomen conservandum*
nom. gen. cons. prop. = *nomen genericum conservandum propositum*; generic name proposed for conservation
nom. illeg(it). = *nomen illegitimum*; illegitimate name
nom. leg(it). = *nomen legitimum*; legitimate name
nom. nov. = *nomen novum*; new name
nom. nud. = *nomen nudum*; name published without description and without reference to previous publications
nom. rej(ic.) = *nomen rejiciendum*; name rejected by the International Rules of Botanical Nomenclature
nom. seminudum = a name which is provided with some unessential notes or details which cannot be considered to represent a sufficient description which is, according to the International Rules of Botanical Nomenclature, compulsory for valid publication of the name of a taxon
nom. subnudum = *nomen seminudum*
nom. superfl. = a name superfluous when it was published; in most cases it is a name based on the same type as an other earlier specific name
non followed by author's name and year, not placed in parentheses, and put at the end of a citation = means that this author has published the same name mentioned in the citation *independently*. These names (combinations) are therefore homonyms.
Compare 56b line 5–4 from bottom. The same can happen with generic names.
(*non* followed by abbreviation of author's name) before a reference (citation) headed by an other author's name = means that the second author has misinterpreted the taxon of the first author.
Compare p. 419a under species 47 the synonym *H. celebica*. DIELS misapplied the name *H. celebica* as earlier described by BURCK.
non al. = *non aliorum*; not of other authors
non vidi = not seen by the author
nov. = *nova* (femin.); new (species, variety, *etc.*)
Nov. = November
n.s. = new series
n. sp. = *nova species*; new species
n. (sp.) prov. = *nomen (specificum) provisorium*; provisional new (specific) name
n.v. = *non vidi*; not seen
NW. = northwest
Oct. = October
op.cit. = *opere citato*; in the work cited
p. = *pagina*; page
P. = Pulau, Pulu (in Malay); Island
Pal(emb.) = Palembang
Pamp. = Pampángan (Philip. language)
Pang. = Pangasinán (Philip. language)
paratype = a specimen cited with the original description other than the holotype
part. alt. = for the other part
P. Bis. = Panay Bisáya (Philip. language)
P.I. = Philippine Islands
pl. = plate
plurim. = *plurimus*; most
p.p. = *pro parte*; partly
pr. max. p. = *pro maxima parte*; for the greater part
pro = as far as is concerned
prob. = *probabiliter*; probably
prop. = *propositus*; proposed
Prov. = Province
pr.p. = *pro parte*; partly
pt = part
quae est = which is
quoad basionym, syn., specimina, *etc.* = as far as the basionym, synonym(s), specimen(s), *etc.* are concerned
references = see for abbreviations the list in vol. 5, pp. cxlv–clxv
Res. = Residency or Reserve
resp. = respective(ly)

S = south (after degrees: southern latitude)
S (after a vernacular name) = Sundanese (language)
Sbl. = Sambáli (Philip. language)
SE. = southeast
sec. = *secus*; according to
sect. = *sectio*; section
sens. ampl. (ampliss.) = *sensu amplo (amplissimo)*; in a wider sense, in the widest sense
sens. lat. = *sensu lato*; in a wide sense
sens. str. (strictiss.) = *sensu stricto (strictissimo)*; in the narrow sense, in the narrowest sense
Sept. = September
seq., seqq. = *sequens, sequentia*; the following
ser. = series
s.l. = *sensu lato*; in a wide sense
S.-L. Bis. = Samar-Leyte Bisáya (Philip. language)
Sml. = Sámal (Philip. language)
s.n. = *sine numero*; (specimen) without the collector's number
Sp. = Spanish (language)
sp(ec). = *species*; species
specim. = specimen(s)
sphalm. = *sphalmate*; by error, erroneous
spp. = *species*; species (plural)
Sr = Senior
s.s. = see *sens. str.*
ssp. = *subspecies*; subspecies
s.str. = see *sens. str.*
stat. nov. = *status nova*; proposed in a new rank
Sub. = Subánum (Philip. language)
subg(en). = *subgenus*; subgenus
subsect. = *subsectio*; subsection
subsp. = *subspecies*; subspecies
Sul. = Súlu (Philip. language)
Sum. E.C. = Sumatra East Coast
Sum. W.C. = Sumatra West Coast
Suppl. = Supplement
SW. = southwest
syn. = *synonymum*; synonym
synonyms = the names of taxa which have been referred to an earlier described taxon of the same rank and with which they have been united on taxonomical grounds or which are bound together nomenclaturally
syntypes = the specimens used by the original author when no holotype was designed or more specimens were simultaneously designated as type
t. = *tabula*; plate
Tag. = Tagálog (Philip. language)
Tagb. = Tagbanúa (Philip. language)
Tagk. = Tagaká-ólo (Philip. language)
Tapan. = Tapanuli (in NW. Sumatra)
taxon = each entity throughout the hierarchic ranks of the plant kingdom which can be described and discriminated from other taxa of the same rank
Taxon. = Taxonomy
Tg = Tandjung (Malay); cape
Ting. = Tinggián (Philip. language)
Tir. = Tirurai (Philip. language)
transl. = translated
type = each taxon above the rank of a species is typified by a type belonging to a lower rank, for instance a family by a genus, a genus in its turn by a species; a species or infraspecific taxon is typified by a specimen. The name of a taxon is nomenclaturally permanently attached to its type; from this it cannot be inferred that the type always represents botanically the most typical or average structure found in the circumscription of the taxon.
type specimen = the specimen or other element to which the name of a species or infraspecific taxon is (nomenclaturally) permanently attached; botanically a type specimen is a random specimen on which the name was based by description. Therefore, it does not need to represent the average or most typical representative of a population. See holotype, isotype, lectotype, syntype, paratype, and neotype
typ. excl. = *typo excluso*; type excluded
typ. incl. = *typo incluso*; type included
typus = see type and type specimen
var. = *varietas*; variety
var. nov. = *varietas nova*; new variety
Vern. = Vernacular
vide = see
viz. = *videlicet*; namely
vol. = volume
W = west (after degrees: western longitude)
Yak. = Yakán (Philip. language)
± = about
& = and
∅ = diameter
♂ = male (flower, *etc.*)
♀ = female (flower, *etc.*)
☿, ⚥ = bisexual (flower)
(♂) (♀) = dioecious with unisexual flowers
(♂♀) = monoecious with unisexual flowers
(♂☿) = polygamous
(♀☿) = polygamous
∞ = many
> = more than (in size, number, *etc.*)
< = less than (size, number, *etc.*)
× 2/5 = 2/5 of natural size
× *montana* = means that the epithet *montana* is that of a hybrid

CHRYSOBALANACEAE (G.T. Prance, Kew)[1]

Trees or shrubs (or rarely suffrutices outside Malesia). *Leaves* simple, alternate, often coriaceous, glabrous or with an indumentum on undersurface, margin entire; petioles often with 2 lateral glands. *Stipules* 2, minute and caducous to large and persistent, usually linear-lanceolate. *Inflorescence* racemose, paniculate or cymose; flowers bracteate and usually bibracteolate; bracts and bracteoles small and caducous or larger and enclosing flower or groups of flowers and persistent. *Flowers* actinomorphic to zygomorphic, hermaphrodite or rarely polygamous, markedly perigynous. *Receptacle* campanulate to cylindrical or rarely flattened cupuliforum, often gibbous at base; calyx lobes 5, imbricate, often unequal, erect or reflexed. *Petals* 5 (absent in some Neotropical species), inserted on margin of disk, commonly unequal, imbricate, deciduous, rarely clawed. *Stamens* indefinite, 2–60 (to 300 in Neotropics), inserted on margin of the disk, in a complete circle or unilateral, all fertile or some without anthers and often reduced to small tooth-like staminodes; filaments filiform, free or ligulately connate, short and included to long and far exserted; anthers small, 2-locular, longitudinally dehiscent, glabrous or rarely pubescent. *Ovary* basically of three carpels but usually with only one developed, the other two aborted or vestigial, variously attached to (the base, middle or mouth of) receptacle, usually sessile or with short gynophore, pubescent or villous; ovary unilocular with two ovules or bilocular with one ovule in each locule. *Ovules* erect, with micropyle at base (epitropous). *Style* filiform, basally attached; stigma 3-lobed or truncate. *Fruit* a fleshy or dry drupe of varied size, interior often densely hairy; endocarp much varied, thick or thin, fibrous or bony, often with a special mechanism for seedling escape. *Seed* erect, exalbuminous, the testa membraneous; cotyledons amygdaloid, plano-convex, fleshy, sometimes ruminate. *Germination* hypogeal with the first leaves opposite or alternate or epigeal with opposite first leaves.

An extensive review of the generic limits of the family has been published: G.T. Prance & F. White, The genera of *Chrysobalanaceae*: a study in practical and theoretical taxonomy and its relevance to evolutionary biology, Phil. Trans. Roy. Soc. London 320 (1988) 1–184. This contains full details of taxonomic history, morphology, anatomy, pollen, ecology and distribution of the family. A condensed version of these subjects is given here. Details of the Neotropical members of the family are given in: G.T. Prance, *Chrysobalanaceae*, Flora Neotropica 9 (1972) 1–410. The African members of the family were treated in: F. White, The taxonomy, ecology and chorology of African *Chrysobalanaceae* (excluding *Acioa*), Bull. Jard. Bot. Nat. Belg. 46 (1976) 265–350.

Distribution. Pantropical with 456 species in 17 genera; 365 species in the Neotropics, 57 in Africa, and 34 in Asia, Malesia and the Pacific.

Seven genera are native to the Flora Malesiana region and one species of an eighth genus, *Chrysobalanus*, from Africa and South America, has naturalized in Malesia and Fiji and is therefore included in this treatment. All four tribes of *Chrysobalanaceae* are represented in the region. The genera treated here fall into the following tribes of Prance & White:

Tribe **Chrysobalaneae**: *Chrysobalanus, Licania, Parastemon.*

(1) Drawings made by Bobbi Angell, David Woolcott, Kirsten Tind, and Julia Loken; David Johnson assisted with the distribution maps.

Tribe **Parinarieae**: *Hunga, Parinari.*

Tribe **Couepieae**: *Maranthes.*

Tribe **Hirtelleae**: *Atuna, Kostermanthus.*

The genera *Atuna, Hunga, Kostermanthus*, and *Parastemon* are confined to the Malesian and Pacific region. *Licania* is predominantly a Neotropical genus (186 species there) with a single species in West Africa and three in Malesia. *Parinari* is a pantropical genus with almost equal representation in all three major regions of the tropics, and *Maranthes* is predominantly an African genus with one abundant and widespread species in Malesia and the Pacific and a single closely related species in Central America.

Morphology. All species of *Chrysobalanaceae* are woody and most are trees or treelets. All are leptocaul. Several, including species of *Atuna*, *Kostermanthus, Licania* (Neotropical), *Magnistipula* (African), *Maranthes* and *Parinari*, exceed a height of 30 m and are important constituents of the upper forest canopy or are emergents. Six African and Neotropical species belonging to *Licania, Magnistipula* and *Parinari* are geoxylic suffrutices with massive woody underground parts, but rather exiguous aerial shoots which are capable of only limited upward growth and a similar form occurs in *Parinari nonda* in Australia.

In their architecture and growth-dynamics those *Chrysobalanaceae* that have been studied exhibit the model of TROLL. This has been demonstrated only in African and Neotropical species.

Herbarium specimens of *Atuna* show a distinct pattern of branching which is difficult to describe except in terms of development based on the living plant.

Buttresses are normally absent but frequently well-developed in some species of *Parinari* and *Atuna*, for example, *P. canarioides, P. costata, P. oblongifolia, A. cordata* and *A. excelsa*, and the trunk of some species of *Parinari, e.g. P. parva* and *P. gigantea* is often fluted at the base.

The leaves, which are simple and spirally inserted, are frequently arranged distichously. Most species have stiff, coriaceous, evergreen leaves which contain abundant silica inclusions.

Stipules are nearly always present but are sometimes small and caducous. In some Neotropical species of *Parinari* the stipules reach a length of 7 cm, they are up to 4 cm in *Parinari parva.* In *Atuna* they are prominently keeled, a unique feature in the family.

The lamina is entire, in all Malesian species. In nearly all species of *Parinari*, and a few Neotropical species of *Licania*, the veins on the lower surface are extremely prominent and form a dense network occupying more than half of the leaf surface so that the stomata are confined to relatively small sunken crypts which are densely filled with short curly hairs.

Foliar glands occur in most, possibly all, species. They secrete nectar which is eaten by ants, and function chiefly on young leaves. On mature leaves of herbarium specimens they are not always clearly visible. The structure and distribution on the leaf of the glands varies greatly from genus to genus and provides characters of considerable taxonomic importance. Small discoid glands occur in various places on the lower surface or margins of the lamina in *Parastemon.* There are larger, sometimes ill-defined, glandular areas towards the base of the lamina in *Maranthes.* In *Parinari* conspicuous glands occur on the petiole.

The inflorescence is very variable. In *Chrysobalanus* the few-flowered inflorescence is a short raceme of cymules or is cymose throughout, or is a false raceme or a subsessile fascicle. In *Parastemon* the inflorescence is a simple or branched raceme. *Hunga* and Malesian species of *Licania* have simple or branched racemes of usually congested cymules. More complex mixed inflorescences with cymose ultimate units are found in *Kostermanthus* and *Parinari*, and the inflorescence of *Maranthes* is corymbose.

Since the inflorescence is usually cymose, at least in part, a distinction between bract and bracteole cannot always be drawn. Bracts and bracteoles are usually small but in nearly all species of *Parinari* they are relatively large and enclose small groups of developing flowers.

In most species the flowers appear to be bisexual, but future field work may show that this is not always so. *Parastemon urophyllus* is said to be polygamodioecious.

Floral symmetry varies from almost completely actinomorphic, apart from the lateral style, in

Chrysobalanus, *Parastemon*, and most species of *Licania* to strongly zygomorphic in *Kostermanthus*. Actinomorphic flowers are patelliform or shallowly cupuliform, and zygomorphic flowers usually have a long receptacle-tube, but in *Kostermanthus* the strongly zygomorphic flowers have a very short receptacle. In the *Chrysobalanaceae* the receptacle-surface is always lined with nectar-secreting tissue, which sometimes, as in *Maranthes corymbosa*, almost completely fills the tube. In most genera the entrance to the receptacle tube is blocked by long straight retrorse hairs, but these are lacking in *Kostermanthus*. In *Parastemon* the nectariferous lining of the receptacle is freely exposed.

There are always five, completely free, slightly to strongly imbricate sepals which vary from subequal in *Chrysobalanus* to markedly unequal in *Kostermanthus*. In most genera they are acute or subacute but in *Kostermanthus* and *Maranthes* they are suborbicular and deeply concave.

Petals are present in all Malesian species but absent in many Neotropical species of *Licania*. There are always five. They are mostly caducous. In shape they vary from linear-spathulate (*Chrysobalanus*) to orbicular. They are usually subequal, but in *Kostermanthus* they are very unequal in shape and size and are strongly unguiculate.

Stamens vary in number from two in *Parastemon urophyllus* to 40 in *Maranthes*. In *Chrysobalanus*, most species of *Licania*, *Parastemon versteeghii*, and *Maranthes* they form a complete or almost complete circle round the entrance to the flower and all or most are fertile. Otherwise the fertile stamens are inserted unilaterally opposite the carpel. Staminodes are frequently present opposite the style. In several genera the filaments appear to be united at the base, but it is sometimes difficult to decide whether this represents true union or whether the filaments are free but inserted on a development of a receptacular rim. In *Maranthes* the stamens are inserted in two or more rows on the outer surface of what appears to be a receptacular annulus. In length the filaments vary from much shorter than the calyx, as in *Hunga*, *Parastemon* and some species of *Licania*, to very much longer in *Maranthes*. In *Kostermanthus* the filaments are united for at least half of their length to form a conspicuous ligule.

The gynoecium fundamentally is composed of three carpels which are free except for the gynobasic style. In most species there is only one functional carpel, though one or two small rudimentary carpels can sometimes be seen. Due to the development of a false dissepiment the ovary is bilocular in *Hunga*, *Parinari*, and *Atuna*.

The fruit is basically a drupe but there is considerable variation in detail, apparently associated with dispersal and germination. In *Chrysobalanus*, *Parastemon* and *Hunga* the endocarp has a smooth surface and is sharply differentiated from the mesocarp. In the other genera the differentiation is less well-defined. In *Chrysobalanus* and *Hunga*, seedling escape is effected by means of longitudinal lines of weakness. In *Parastemon* and *Maranthes* two large lateral plates fall away permitting the seedling to emerge. In *Parinari* there are two small basal 'plugs' or obturators. All other genera seem to lack specialized means of seedlings escape.

In *Chrysobalanus*, *Licania*, *Parastemon*, *Parinari*, and *Atuna*, germination is cryptocotylar, whereas in *Maranthes* it is phanerocotylar.

Vegetative Anatomy. – *Leaf anatomy*. Indumentum, if present, consisting of long unicellular hairs. Variously positioned glands (extrafloral nectaries) with slender upright epidermal secretory cells commonly present. Wax present as platelets (FEHRENBACH & BARTHLOTT, 1988). Stomata mostly paracytic, confined to the lower leaf surface. Upper epidermis often composed of tall cells; with mucilaginous inner walls in some species. Hypodermis often present. Mesophyll entirely composed of palisade-like cells, more rarely dorsiventral and differentiated into palisade and spongy tissue. Asterosclereids occasionally present in mesophyll. Veins mostly with sclerenchyma sheaths including sclereids with U-shaped wall thickenings, sometimes vertically transcurrent. Midrib and distal end of petiole with a closed vascular cylinder, with or without additional adaxial or medullary collateral bundles. Silica bodies and silicified cell walls common, especially in epidermis.

Young stem. Cork arising superficially. Pericyclic sclerenchyma ring composed of fibres and sclereids with U-shaped wall thickenings. Secondary phloem occasionally with secretory (tannin?) cells. Sieve tube plastids of the S-type (BEHNKE, 1984). Silica bodies often present in pericycle, phloem and xylem rays, and in pith.

Wood anatomy. Growth rings absent or, if present, defined by differences in the spacing of tangential parenchyma bands. Vessels diffuse, often in a weakly oblique pattern, (almost) exclusively solitary, tending to be of two distinct sizes, the larger ones very wide (200–300 µm). Vessel perforations simple. Tyloses often present in heartwood, sclerotic in some species. Vessel–ray pitting including elongate horizontal or oblique to almost vertical pits with strongly reduced borders, often unilaterally compound. Fibres often thick-walled, with distinctly bordered pits throughout the tangential walls, and in the radial walls often confined to fibre–ray contacts (fibre-tracheids); in contact with vessels often less thick-walled and with biseriate bordered pits (= vasicentric tracheids). Parenchyma in fine uniseriate or locally bi(–tri)-seriate, regular or irregular wavy tangential bands. Parenchyma strands typically long, of up to 16 cells. Some axial parenchyma cells with spiral thickenings in *Atuna p.p., Licania, Maranthes p.p.*, and *Kostermanthus* (TER WELLE, 1975). Rays predominantly uniseriate, but in some taxa also biseriate, typically weakly heterogeneous with (often weakly) procumbent central cells and one row of square to upright marginal cells (Kribs type III), sometimes homogeneous and composed of procumbent cells only. Silica bodies universally present in ray cells, more rarely in axial parenchyma cells. Rhomboidal crystals in chambered axial parenchyma cells noted in *Parastemon*.

Taxonomic notes based on vegetative anatomy. The above general anatomical description is based on the literature (for leaf and young stem anatomy mainly KÜSTER, 1897, as abstracted by SOLEREDER, 1899; and PRANCE, 1972, and PRANCE & WHITE, 1988, for wood anatomy from many sources), amplified with original observations on slides present in the Rijksherbarium at Leiden. A number of anatomical characters may prove to be of considerable taxonomic significance at the genus or species level (mucilaginous leaf epidermis, distribution of silica grains in leaves, young stem, and wood, vascular pattern and sclerenchyma support of leaf veins and petiole, fibre and sclereid distribution pattern of the mature bark (ROTH, 1981), spiral thickenings in axial parenchyma cells of the wood, ray width and histology, *etc.*). However, for the Malesian *Chrysobalanaceae* their diagnostic value remains largely untested. On the whole the *Chrysobalanaceae* are anatomically rather homogeneous, and as repeatedly emphasized, quite distinct from the *Rosaceae*. Anatomically *Chrysobalanaceae* are also distinct from the numerous families to which they have been compared in the search for closest relatives.

References: BEHNKE, Ann. Missouri Bot. Gard. 71 (1984) 824–831; DESCH, Manual of Malayan Timbers 2 (1954) 474–485; BURGESS, Timbers of Sabah (1966) 434–436; FEHRENBACH & BARTHLOTT, Bot. Jahrb. 109 (1988) 407–428; FURUNO, Anatomy of Papua New Guinea Wood (Continued), Res. Report of Foreign Wood 8, Shimane Univ. (1979); HAYASHI *c.s.*, Micrographic Atlas of Southeast Asian Timber, Kyoto Univ. (1973); LECOMTE, Les bois de l'Indochine (1926) 59–61; METCALFE & CHALK, Anatomy of the Dicotyledons 1 (1950) 550–553; MOLL & JANSSONIUS, Mikrographie des Holzes der auf Java vorkommenden Baumarten 3 (1914) 222–230; PRANCE, Flora Neotropica 9 (1972) 1–19; PRANCE & WHITE, Phil. Trans. Roy. Soc. Lond. B 320 (1988) 1–184; ROTH, Encycl. Plant Anatomy 9, 3 (1981) 286–295, 402–403; SOLEREDER, Systematische Anatomie der Dicotyledonen (1899) 341–351; TER WELLE, Acta Bot. Neerl. 24 (1975) 397–405; IAWA Bulletin 1976/2 (1976) 19–29; TER WELLE & DÉTIENNE, Flora of the Guianas A 85 (1986) 109–126. – P. BAAS.

Palynology. The pollen of *Chrysobalanaceae* is very uniform, but is different from that of *Rosaceae*. It is of little value for distinguishing between the genera of *Chrysobalanaceae* or for arranging them in groups.

Most species have grains with three furrows, but some species have three or four; there are no special features except occasional equatorial constrictions. With light microscopy the pores are indistinct, and in some species are difficult to observe. The grains are usually distinctly triangular in shape in polar view, except when four-furrowed; they are elliptical to circular in equatorial view and are oblate-spheroidal, prolate-spheroidal or subprolate in shape as indicated by the ratio: polar length $\times 100$, divided by the equatorial length $= 85-150$. The size is very variable from one genus to another; the polar area is usually small, sometimes medium, but never large. The exine is medium to rather thick with very little patterning; it is usually scabrous to verrucose, but never striate.

The pollen of *Chrysobalanaceae* and *Rosaceae* is similar but readily distinguishable. The former is markedly triangular in polar view in the expanded grain, whereas in *Rosaceae* it is never more than weakly triangular. Most *Rosaceae* have more distinctive pores, and many have more patterning on the wall. A feature that occurs frequently in the *Rosaceae* is a distinct wedge-shaped protrusion from the middle of the furrow, obvious in polar view, which does not occur in *Chrysobalanaceae*.

ERDTMAN (1952) states 'pollen morphological objections cannot be raised against regarding the *Chrysobalanaceae* as a separate family.' Our own study of *Rosaceae* pollen (*sensu lato*) confirmed that three main types of pollen occur: the *Rosaceae sensu stricto*, the *Chrysobalanaceae*, and the *Neuradoideae* types (PRANCE, 1963). The differences between pollen of *Chrysobalanaceae* and *Rosaceae* are, however, comparatively small. By contrast, the pollen of the *Tropaeolaceae, Geraniaceae, Limnanthaceae, Linaceae, Polygalaceae*, and *Sapindaceae*, families which various phylogenists (HALLIER, 1923; BONNE, 1926; HAUMAN, 1951; GUTZWILLER, 1961) have suggested are closely related to *Chrysobalanaceae*, is very different. Pollen morphology thus provides reasons for keeping the *Chrysobalanaceae* near to the *Rosaceae* in the *Rosales*, and not for removing it to the *Geraniales* or *Sapindales*.

The pollen of *Chrysobalanaceae* is so uniform that it does not provide good generic characters. *Kostermanthus heteropetala* is distinct from all other *Chrysobalanaceae* examined, including *Dactyladenia* (Africa) and *Acioa* (America) with which it shares a staminal ligule, in having three swellings on each of the triangular sides of the grain in polar view. Apart from *Kostermanthus* no other genus is clearly definable on pollen characters.

References: BONNE, C. R. Hebd. Séanc. Acad. Sci. Paris 182 (1926) 1404–1406; ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 380–383; GUTZWILLER, Bot. Jahrb. 81 (1961) 1–49; HALLIER, Beih. Bot. Centralbl. 39 (1923) 1–178; HAUMAN, Bull. Jard. Bot. État Brux. 21 (1951) 167–198; PRANCE, A taxonomic study of the *Chrysobalanaceae*. Thesis, Oxford (1963).

Phytochemistry. Chemical knowledge about the family *Chrysobalanaceae* is still scanty. HEGNAUER (1973) treated it as *Chrysobalanoideae sub Rosaceae. Chrysobalanaceae* are noteworthy for their tendency to accumulate silica (SiO_2) in leaves and in the wood where usually every ray cell contains one globular silica inclusion. Leaf flavonoid patterns are dominated by the flavonols quercetin and kaempferol; some taxa also have myricetin. Proanthocyanidins (formerly called leucoanthocyanidins), *i.e.* condensed tannins, were demonstrated to be present in leaves of few species of *Chrysobalanus, Licania*, and *Parinari*, but galli- and ellagitannins have not yet been traced in the family. The recent flavonoid investigation of 21 species of *Parinari* (CORADIN, GIANNASI & PRANCE, 1985) resulted in the identification of a number of 3-glycosides of kaempferol, quercetin and myricetin, and showed restriction of myricetin glycosides to four African species; dihydroquercetin('taxifolin')-3-glycosides were noticeable only in Asian *Parinari insularum* from the Pacific islands and vicenin-like C-glycoflavones only in a few African populations of *P. excelsa*. Myricetin was also observed in leaves of *Licania macrophylla* which besides has much condensed tannins in all parts, saponins in leaf, pericarp, seed, and stem and root bark; alkaloids in stem and root bark (GRENAND, MORETTI & JACQUEMIN, 1987). Cyanogenic glycosides which are characteristic of a number of Rosaceous taxa have not been traced in *Chrysobalanaceae* hitherto. The most noteworthy chemical character known from the family at present is the fatty acid pattern of their seed triglycerides; conjugated trienoic and tetraenoic C_{18}-acids such as alpha-elaeostearic and parinaric acids are present as major fatty acids in seed oils of species of *Chrysobalanus, Licania*, and *Parinari s.l.* (*i.e.* including *Atuna, Maranthes* and the African *Neocarya*).

This character, however, which links *Chrysobalanaceae* biochemically with *Prunoideae* (same type of seed oils in some *Prunus s.l.* species) seems not to be universal in the family. According to JONES & EARLE (1966) seed kernels of a species of *Couepia* (Central & South America) contained an oil without conjugated unsaturation. Still too little is known from the chemistry of this taxon to allow a sound chemotaxonomic discussion.

References: CORADIN, GIANNASI & PRANCE, Brittonia 37 (1985) 169–178; GRENAND, MORETTI & JACQUEMIN, Pharmacopées traditionelles en Guyane, ed. ORSTOM, Paris (1987); HEGNAUER, Chemotaxonomie der Pflanzen 6 (1973) 84–130; JONES & EARLE, Econ. Bot. 20 (1966) 137; PRANCE & WHITE, Phil. Trans. Roy. Soc. London B 320 (1988) 28–29. – R. HEGNAUER.

Dispersal. The fruits of *Chrysobalanaceae* are very uniform in basic structure but remarkably diverse in functional detail. Despite their uniformity they have become adapted to a wide range of dispersal agents, sometimes within a single genus or species; however, few species have been studied in the field.

Chrysobalanus icaco ssp. icaco is dispersed by ocean currents, and also by bats, rodents and monkeys, and possibly by birds; *C. cuspidatus* is said to be dispersed by birds.

Some Neotropical species of *Licania* are bat-dispersed, whereas the fruits of several South American riverine species float and are also eaten by fish; those of the African species *L. elaeosperma* are also transported by water. The Malesian species *L. splendens* is dispersed by the fruit pigeon *Ducula aenea.*

Various species of *Parinari* are known to be dispersed by bats, elephants, baboons and other primates, a scatter-hoarding squirrel, fruit pigeons, rheas, emus, agoutis and fish. Species of *Couepia, Licania* and *Parinari* are frequently eaten by bats in the Neotropics.

Maranthes corymbosa is dispersed by birds, most notable hornbills and fruit pigeons, and, at least for short distances, by a scatter-hoarding squirrel. The fruits of some African species are eaten by monkeys which are possibly mainly destructive.

Atuna is dispersed by ocean currents and a scatter-hoarding squirrel and possibly by wild pigs.

Uses. Members of the *Chrysobalanaceae* are used by the local people everywhere, for building, fuel, charcoal and in folk medicine. The fruits and seeds of some species are highly esteemed, and others are eaten in times of scarcity; some are used in the preparation of alcoholic beverages. At present, *Chrysobalanaceae* are only of local importance commercially, but, with improved communications and technology, their potential as a source of construction timber, fruits, and edible and industrial oils appears to be promising.

The Malesian standard timber name for various genera of *Chrysobalanaceae* is *merbatu.*

Edible fruits and seeds. Chrysobalanus icaco is tinned and bottled in syrup and sold in Colombia and Venezuela under the name *Icacos.* The fruit of several Neotropical species of *Couepia* and *Parinari* are eaten. In Amboina a dish called *Koku koku* is prepared from the mashed seeds of *Atuna excelsa* mixed with raw or fried small fish, ginger, onions, chillies and lime juice.

Wood. Despite the large supplies of *Chrysobalanaceae* wood potentially available, commercial sawn timber is produced only in relatively small amounts. This is because its high silica content blunts even tungsten-tipped saws. Because the wood of many species is resistant to marine borers, it is used throughout the tropics for piers and other marine constructions.

Caulking and waterproofing agent. In the Solomon Islands the principal use of *Atuna excelsa sensu lato* is for caulking the seams of plank-built canoes. The seeds, which are known as 'putty nut' are pounded to a putty-like consistency. After application the putty hardens and darkens, but if exposed too long to the sun it cracks, so canoes drawn up on the beach are often kept in the shade of sheds. In the central and south-eastern Solomons it is used for setting shell inlay in wood bowls, figures and other articles. The north-western Solomon Islanders also use it for waterproofing bottles made from gourds. In the Admiralty Islands (Manus) coiled baskets are coated with it to make them waterproof (B.A.L. CRANSTONE, in litt., 14 June 1983).

History of *Parinari.* The taxonomic history of *Parinari* is complex. At least some species of all Malesian genera except *Chrysobalanus*, and *Parastemon* have at one time or another been placed in *Parinari.*

All species of *Atuna* and *Maranthes* have been included in *Parinari*. Despite their considerable differences from *Parinari sensu stricto* in virtually all other respects, these genera have one feature in common – a bilocular ovary. It was the adoption of this character as a generic criterion, especially by BENTHAM (1849), that led to the increasingly artificial nature of *Parinari*. As *Parinari* became more and more heterogeneous even some species with unilocular ovaries were included, for example, the species now placed in *Kostermanthus*.

In the original description of *Parinari*, which was based on *P. campestris* and *P. montana* from French Guiana, AUBLET (1775) mentioned the bilocular ovary, but he does not appear to have attached much importance to it.

DE JUSSIEU (1789), who brought all previously described genera of *Chrysobalanaceae* together for the first time, knew some of them only from the original descriptions and illustrations. His implication that *Parinari* differs from the other genera principally in its bilocular ovary seems to have laid the foundations for the subsequent confused history of the group.

DE JUSSIEU was the first to extend the concept of *Parinari* to another continent by citing in synonymy two manuscript names of ADANSON from Senegal, *Mampata* and *Neou*. The former was subsequently described as *P. excelsa* and the latter as *P. macrophylla* by SABINE.

The following year, in his Prodromus, DE CANDOLLE (1825), who only knew the four species mentioned above, divided *Parinari* into two sections. Section *Petrocarya* (correctly section *Parinari*) was based on a superfluous generic name which SCHREBER (1789) substituted for the earlier *Parinari*. It included AUBLET's original species. Section *Neocarya* was based on *P. senegalensis* DC. [now *Neocarya macrophylla* (SABINE) PRANCE], but *P. excelsa* was associated with it, probably because its type-description is inadequate to characterize it properly. *Parinari macrophylla* is not mentioned by DE CANDOLLE. He was also apparently unaware of the first true *Parinari* to be described from Asia, *P. sumatrana* BENTH., which had been described by JACK in the illegitimate genus *Petrocarya* in 1822. DE CANDOLLE indirectly emphasized the importance of the bilocular ovary of *Parinari* by describing the ovary of all other genera as unilocular.

During the first half of the nineteenth century, in addition to *Neocarya macrophylla*, a few other species, which belong to other genera, were described in *Parinari* or its illegitimate synonym *Petrocarya*, because of their bilocular ovary. Thus JACK (1822) described *Petrocarya excelsa* (now *Atuna excelsa*), and BENTHAM (1840) published *Parinari coriacea* (now *Exellodendron coriacea*), but it was BENTHAM's treatment of *Parinari* in HOOKER's Niger Flora (1849) that firmly established *Parinari* as an artificial genus.

Whereas earlier workers had implied that the bilocular ovary is a diagnostic character of *Parinari*, BENTHAM referred to the spurious dissepiment which separates the ovules as 'the essential character.' BENTHAM divided *Parinari* into three sections as follows:

Section 1: *Petrocarya* (correctly *Parinari*) included the African species *P. excelsa* and *P. curatellifolia*, all the known American species including *P. coriacea* (now *Exellodendron coriaceum*), and, with some doubt, three species BENTHAM had not seen himself, namely *P. sumatrana* BENTH. (a true *Parinari*), *P. glaberrima* HASSK. (now *Atuna excelsa*) and *P. scabra* HASSK. (now *Atuna scabra*).

Section 2: *Sarcostegia* BENTH. included two new species, *P. polyandra* (now *Maranthes polyandra*) and *P. griffithiana* (now *Maranthes corymbosa*), and, with some doubt, also *P. jackiana* BENTH. (based on *Petrocarya excelsa*, now *Atuna excelsa*) which BENTHAM had not examined.

Section 3: *Neocarya* DC. contained *P. macrophylla* (now *Neocarya macrophylla*) and its synonym *P. senegalensis*.

BENTHAM's circumscription of *Parinari* was probably much wider than he imagined, largely because of the inclusion of the Asian species he only knew from the literature. He appears to have adopted it with some reservation. *Parinari polyandra* has *c.* 40 fertile stamens and BENTHAM mentions that this, in conjunction with the glandular leaves and fleshy 'calyx', might 'suggest the establishment of a distinct genus.' He clearly believed that the stamen number of *Parinari* varies more or less continuously, but the evidence he cites is partly on the species he had not studied.

BENTHAM's circumscription of *Parinari* included five genera which are now regarded as distinct, namely, in additon to *Parinari* itself, *Atuna* RAFIN., *Exellodendron* PRANCE, *Maranthes* BLUME and *Neocarya* PRANCE. Two of these from Malesia had enjoyed a brief period of generic recognition. Thus, *Maranthes* was described by BLUME in 1825, but three years later he transferred the type species to his illegitimate *Exitelea*. *Atuna* was described by RAFINESQUE in 1838, but remained disregarded for more than 100 years, though one of its species was independently described by HASSKARL in 1842 as the type of his new genus *Cyclandrophora*. It appears that HASSKARL had little faith in his new genus for he united it with *Parinari* within a year of its publication, although it has little in common with the latter, other than the bilocular ovary.

Since BENTHAM (1849) nearly all species of *Chrysobalanaceae* with false dissepiment (and even some without) were automatically placed in *Parinari* regardless of any other consideration.

As new species now placed in *Exellodendron*, *Maranthes* and *Atuna* were described they were all placed in *Parinari*. Likewise, equally disparate elements which are now placed in *Bafodeya* PRANCE, *Hunga* PANCHER *ex* PRANCE and *Kostermanthus* PRANCE joined the assemblage.

KEY TO THE GENERA
based on flowering material

1. Stamens free, not united into a ligule; petals not clawed, ovary uni- or bilocular.
 2. Ovary unilocular, inserted at or near base of receptacle.
  3. Inflorescence a panicle of cymules; fertile stamens 7–26.
   4. 'Stamens 15–26, the filaments hairy, exserted .... **1. Chrysobalanus**
   4. Stamens 7–10, the filaments glabrous, included .... **2. Licania**
  3. Inflorescence racemose; fertile stamens 2 or 5 .... **3. Parastemon**
 2. Ovary bilocular, inserted at mouth or midway up receptacle.
  5. Fertile stamens 6–8(–9), markedly unilateral, the filaments equal or not exceeding the calyx lobes.
   6. Lower leaf surface glabrous or lanate, with stomatal cavities; bracteoles not enclosing small groups of flowers; inflorescence a panicle of cymules; ovary inserted midway up receptacle .... **4. Hunga**
   6. Lower leaf surface usually areolate with stomatal cavities; bracteoles enclosing small groups of flowers; inflorescence a much-branched panicle; ovary inserted at mouth of receptacle .... **5. Parinari**
  5. Fertile stamens 10–50, usually inserted around complete circle; the filaments far exserted beyond calyx lobes.
   7. Stamens 10–25; inflorescence little branched panicles, or racemes .... **6. Atuna**
   7. Stamens *c.* 45; inflorescence much-branched corymbose panicles .... **7. Maranthes**
1. Stamens united into a strap-shaped ligule; the 2 anterior petals unguiculate and enveloping the ligule in buds; ovary unilocular .... **8. Kostermanthus**

KEY TO THE GENERA
based on fruiting material

1. Epicarp crustaceous-verrucose; mesocarp thick, hard, fibrous; endocarp breaking up irregularly on germination; cotyledons at least slightly ruminate.
 2. Stamens free to base (can often be seen persistent around base of young fruit). Cotyledons ruminate **6. Atuna**
 2. Stamens united into a unilateral ligule. Cotyledons only slightly ruminate .... **8. Kostermanthus**
1. Epicarp smooth and glabrous or distinctly lenticellate but not crustaceous; if lenticellate then endocarp opening by a pair of basal stoppers to allow seedling escape. Cotyledons not ruminate.
 3. Epicarp lenticellate; opening by a pair of basal stoppers to allow seedling escape, always thick and woody; fruit bilocular, but often only one loculus developing seed .... **5. Parinari**
 3. Epicarp glabrous and smooth without lenticels; opening by lateral plates, longitudinal lines or no special mechanism of seedling escape; fruit uni- or bilocular.
  4. Endocarp opening by a pair of lateral plates to allow seedling to escape; endocarp thick and woody or thin and bony.
   5. Fruit unilocular; endocarp very thin, bony .... **3. Parastemon**
   5. Fruit bilocular; endocarp thick, woody .... **7. Maranthes**

4. Endocarp not opening by lateral plates, usually opening longitudinally; endocarp thin and bony.
 6. Fruit usually bilocular, 1.5–5 cm long, sometimes sagittate with a distinct stipe, not ridged **4. Hunga**
 6. Fruit unilocular, either 1–1.3 cm long, ellipsoid or 2–5 cm long and ridged.
  7. Fruit ridged. *Leaves* orbicular .... **1. Chrysobalanus**
  7. Fruit smooth, not ridged. *Leaves* oblong to elliptic .... **2. Licania**

1. CHRYSOBALANUS

LINN. Sp. Pl. 1 (1753) 513; DC. Prod. 2 (1825) 525; HOOK. *f.* in Benth. & Hook.*f.*, Gen. Pl. 1 (1865) 606; HOOK. *f.* in Mart., Fl. Bras. 14 (2) (1867) 7; PRANCE, Fl. Neotrop. 9 (1972) 14. – **Fig. 1.**

Shrubs or small trees. *Stipules* small, connate-axillary, caducous. *Leaves* glabrous on both surfaces, without stomatal crypts. Petioles eglandular. *Inflorescence* terminal or axillary cymules or a panicle of cymules. Bracts and bracteoles to 2 mm long, eglandular, not enclosing groups of flower buds. *Flowers* hermaphrodite. *Receptacle* campanulate, symmetric, tomentose on exterior and interior; calyx lobes 5, acute, equal. *Petals* 5, longer than calyx lobes, not clawed. *Stamens* 15–26, all fertile, inserted on margin of disk; filaments hairy, united in groups for half length, exserted. *Ovary* inserted at base of receptacle, densely pilose; carpel unilocular, with 2 ovules. *Style* pubescent. *Fruit* a small fleshy drupe, epicarp smooth and ridged, endocarp hard, thin, glabrous on interior, with 4–8 prominent longitudinal ridges which correspond to lines of fracture for seedling escape.

Distr. Three species, one in West Africa and the Neotropics, two confined to the Neotropics. One species naturalized in *Malesia* and Fiji.

Uses. Edible fruit. The shrub is used for the stabilization of dunes.

1. Chrysobalanus icaco LINN. Sp. Pl. 1 (1753) 513; BROWNE, Nat. Hist. Jamaica (1756) 250; JACQ. Sel. Stirp. Am. Hist. (1763) 155; DC. Prod. 2 (1825) 525; HOOK. *f.* in Mart., Fl. Bras. 14 (2) (1867) 7; PRANCE, Fl. Neotrop. 9 (1972) 15; SMITH, Fl. Vit. Nov. 3 (1985) 50. – **Fig. 1.**

Shrub or small tree to 5 m tall, the branches glabrous and lenticellate. *Stipules* 1–3 mm long, caducous. *Leaves* orbicular to ovate-elliptic, 2–8 by 2–6 cm, retuse, rounded or with short blunt acumen at apex, subcuneate at base, glabrous on both surfaces; petioles 2–4 mm. *Inflorescences* small terminal and axillary cymules or panicles of cymules, the rachis and branches grey-puberulous. *Flowers* 4–6 mm long. *Receptacle* campanulate-cupuliform, symmetrical, tomentose on exterior and interior. Calyx lobes rounded to acute, tomentellous on both surfaces. *Petals* white, glabrous, exserted. *Stamens* 15–26, the filaments joined for up to half of length in small groups, densely hairy, exserted. *Ovary* at base of receptacle, pilose. *Fruit* ovate to obovate, 2–5 cm long; epicarp smooth with longitudinal ridges; mesocarp thin and fleshy; endocarp thin, hard, ridged on exterior.

Distr. Neotropics, mainly in coastal areas; West & Central Africa, naturalized in Fiji, cultivated in Vietnam; in *Malesia* cultivated in Singapore where it has escaped and naturalized. Fig. 1D.

Ecol. Dunes, beaches and coastal scrub.

Uses. Edible fruit.

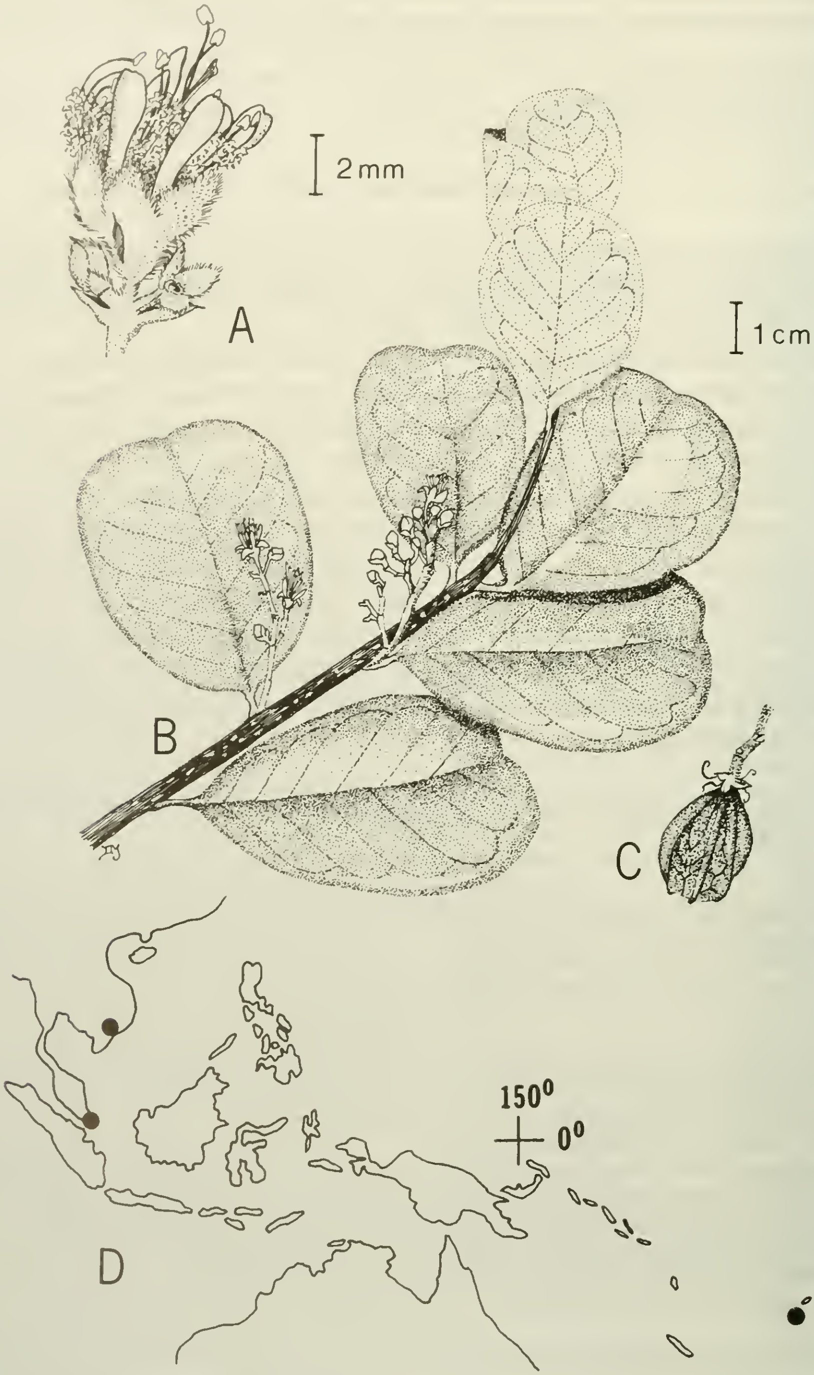

Fig. 1. *Chrysobalanus icaco* LINN. *A*. Detail of flower; *B*. habit; *C*. fruit; *D*. distribution in Malesia.

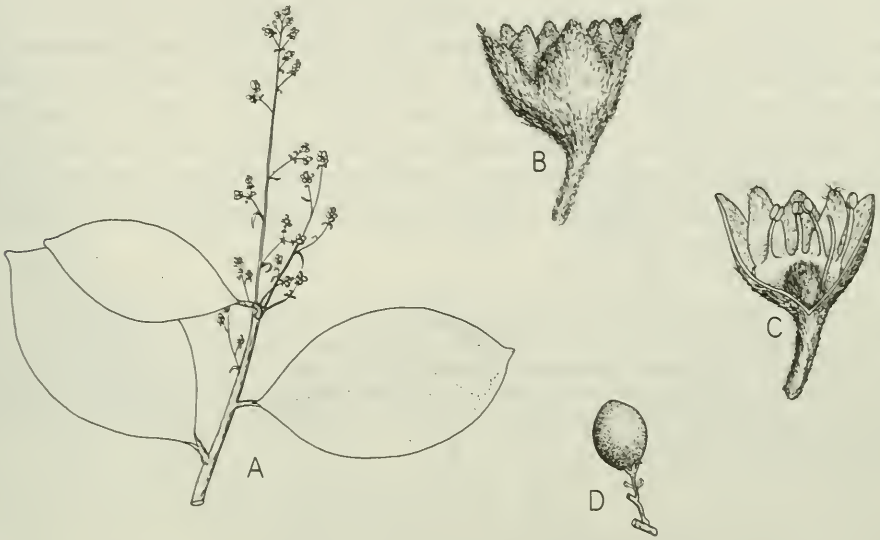

Fig. 2. *Licania splendens* (KORTH.) PRANCE. *A*. Habit, ×0.5; *B*. flower, ×9; *C*. flower section, ×9; *D*. fruit, ×1 (*A–C* ELMER 20916, *D* RAMOS & CONVOCAR 83437).

2. LICANIA

AUBL. Hist. Pl. Guiane Fr. 1 (1775) 119, t. 45; DC. Prod. 2 (1825) 527; HOOK. *f.* in Benth. & Hook.*f.* Gen. Pl. 1 (1865) 606; FRITSCH, Ann. Naturh. Mus. Wien 4 (1889) 33; FOCKE in E. & P. Nat. Pfl. Fam. 3, 3 (1891) 58; PRANCE, Fl. Neotrop. 9 (1972) 21; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 328; WHITE, Bull. Jard. Bot. Nat. Belg. 46 (1976) 280; PRANCE, Brittonia 31 (1979) 94. – *Moquilea* AUBL. Hist. Pl. Guiane Fr. 1 (1775) 521, t. 208; DC. Prod. 2 (1825) 526; HOOK. *f.* in Benth. & Hook.*f.*, Gen. Pl. 1 (1865) 606; FOCKE in E. & P. Nat. Pfl. Fam. 3, 3 (1891) 58. – *Dahuronia* SCOP. Introd. (1777) 217, *nom. illeg.* – *Hedycrea* SCHREB. in Linn., Gen. Pl. ed. 8, 1 (1789) 160, *nom. illeg.* – *Angelesia* KORTH. Ned. Kruidk. Arch. 3 (1854) 384; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 424; BURK. Dict. (1935) 159; CORNER, Wayside Trees (1940) 526; HUTCH. Gen. Flow. Pl. 1 (1964) 191. – *Trichocarya* MIQ. Fl. Ind. Bat. 1, 1 (1855) 358; *ibid.* 6 (1858) 1084, *p.p. quoad T. splendens tantum.* – *Geobalanus* SMALL, Fl. Miami (1913) 80; HUTCH. Gen. Flow. Pl. 1 (1964) 191. – *Coccomelia* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 82 (1920) 183; Fl. Mal. Pen. 1 (1922) 671. – *Afrolicania* MILDBR. Notizbl. Bot. Gart. Berlin-Dahlem 8 (1921) 483. – **Fig. 2.**

Small to large trees. Stipules small, free, caducous. *Leaves* glabrous on both surfaces, without stomatal crypts. Petioles eglandular. *Inflorescence* a panicle of cymules. Bracts and bracteoles to 1.5 mm long, membraneous, eglandular, not enclosing groups of flower buds. *Flowers* hermaphrodite. *Receptacle* campanulate, slightly asymmetric, tomentose on exterior, tomentose within; calyx lobes 5, acute, unequal. *Petals* 5, small, not exceeding the calyx lobes, not clawed. *Stamens* 7–10, all fertile, inserted on margin of disk; filaments glabrous, included, slightly united at base. *Ovary* inserted at or near base of receptacle, pilose on exterior; carpel unilocular, with 2 ovules. *Style* pubescent at base, the stigma capitate. *Fruit* a small, fleshy drupe, narrowed to a shortly stipitate base; epicarp smooth, not ridged, glabrous, not lenticellate; mesocarp thin, fleshy; endocarp thin, hard, bony, breaking up in longitudinal lines during germination, tomentose within.

Distr. About 180 species in the Neotropics, one species in West Africa; three species in Malesia from the Malay Peninsula to New Guinea and the Philippines, but not in the Lesser Sunda Islands.

Uses. The timber is strong and durable and resistant to marine borers. It is hard to work because of silica.

Note. The description above is for the Malesian element of *Licania*; the genus is much more variable in the Neotropics. The three Asian species are placed in subgenus *Angelesia* by PRANCE & WHITE, Phil. Trans. Roy. Soc. London 320 (1988) 94.

KEY TO THE SPECIES

1. Fruit 1–1.3 cm long, ellipsoid, not narrowed towards base or apex.
 2. Leaves oblong, the apices distinctly acuminate; inflorescence rachis densely puberulous **1. L. splendens**
 2. Leaves elliptic to oblong-elliptic, the apices acute to rounded and emarginate; inflorescence rachis sparsely puberulous .... **2. L. palawanensis**
1. Fruit 2.5–5 cm long, narrowed at apex and base, fusiform .... **3. L. fusicarpa**

1. Licania splendens (KORTH.) PRANCE, Fl. Neotrop. 9 (1972) 172. – *Angelesia splendens* KORTH. Ned. Kruidk. Arch. 3 (1854) 384; BOERL. & KOORD. Ic. Bog. 1, 4 (1901) 59, t. 96; MERR. Philip. J. Sc. 10 (1915) Bot. 307; Enum. Philip. Pl. 2 (1923) 236; CORNER, Wayside Trees (1940) 526; BROWNE, For. Trees Sarawak & Brunei (1955) 307. – *Licania angelesia* BLUME, Mélang. Bot. 2 (1855) 358. – *Chrysobalanus splendens* KORTH. *ex* MIQ. Fl. Ind. Bat. 1, 1 (1855) 358, in syn. – *Parinarium fragile* TEIJSM. & BINN. Cat. Hort. Bog. (1866) 253, *nom. nud.* – *Parinarium nitidum* HOOK. *f.* Fl. Brit. India 2 (1878) 310. – *Ferolia nitida* (HOOK. *f.*) RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 82 (1920) 183; Fl. Mal. Pen. 1 (1922) 671. – *Parinarium philippinense* ELMER, Leafl. Philip. Bot. 10 (1939) 3809. – **Fig. 2.**

Tree to 25 m tall, the young branches sparsely lanate, soon glabrous. *Stipules* linear-lanceolate, to 3 mm long, caducous. *Leaves* 4–11 by 1.8–4.2 cm, oblong, usually acuminate at apex, cuneate at base, glabrous beneath; petioles 2–5 mm, canaliculate, glabrous when mature. *Inflorescence* terminal and axillary panicles of cymules, 1.5–14 cm long, the rachis and branches grey-puberulous. *Flowers c.* 2 mm long. *Receptacle* campanulate, slightly swollen to one side, grey-tomentellous on exterior, tomentose within; pedicels *c.* 1 mm long. Calyx lobes acute, tomentellous on both surfaces. *Petals* pubescent on exterior. *Stamens* 7–10, slightly unilateral, the filaments glabrous. *Ovary* at or near base of receptacle, unilocular, pilose on exterior. *Fruit* ellipsoid, 1–1.3 cm long; epicarp smooth, glabrous; mesocarp thin, fleshy; endocarp thin, hard, bony, breaking open by longitudinal lines of weakness, tomentose within.

Distr. Thailand; in *Malesia*: Sumatra, Malay Peninsula, W. Java, Borneo, Philippines. Fig. 3.

Ecol. Commonest in forest, including dipterocarp forest, on hill slopes and ridges, but wide-ranging in peat swamp, freshwater swamp forest, on seashores, and in rocky places; 0–400(–800) m altitude.

Uses. The timber is strong, durable and resistant to marine borers and is used for saltwater piles, railroad ties, *etc.* However, it is extremely hard to work and requires special tools because of silica. The fruit is edible but is not widely used.

Vern. Malay Peninsula: *champrai, medang merah, m. puteh, membatu, mempadang, merbatu kechil*; Borneo: *piasau-piasau*, Kedayan, *gandulong*, Dusun, *tampaluan*, Sabah, *sampaluan*, Brunei, *buku-buku, bunga, djentihan burung, mauhi*, Kalimantan; Philippines: *taguilom bay; amayan, balik*, D.Bis., *dagiñgan, dagingdiñgan*, S.L.Bis., *gapas, maralibus*, Tagb.

2. Licania palawanensis PRANCE, Brittonia 31 (1979) 94.

Shrub, young branches sparsely puberulous soon becoming glabrous. *Stipules* lanceolate, 1–2 mm long, glabrous, caducous. *Leaves* 3–6 by 1.4–3 cm,

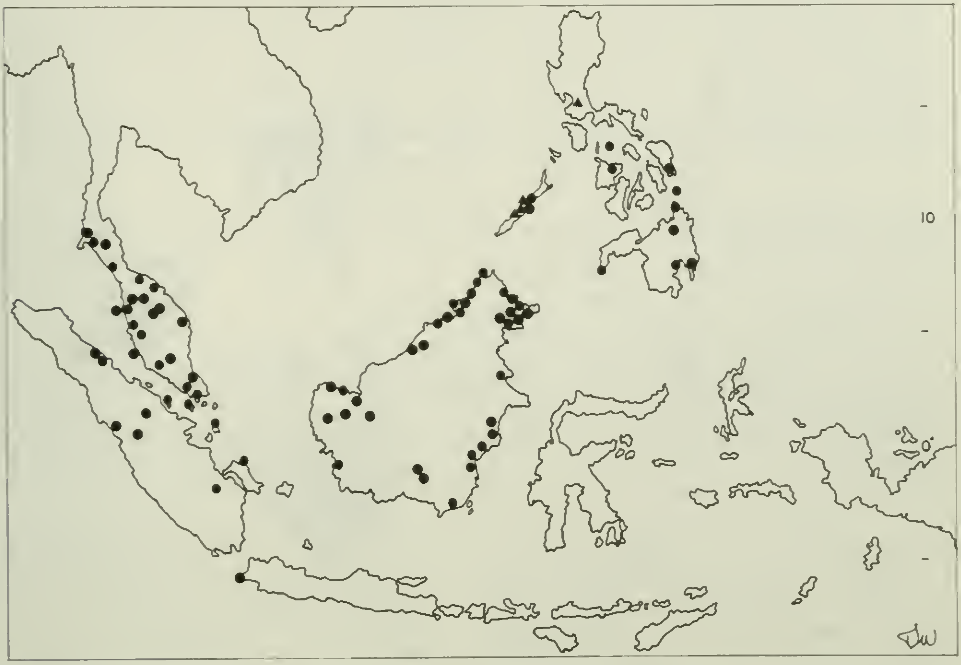

Fig. 3. Distribution of *Licania splendens* (KORTH.) PRANCE (dots) and *L. palawanensis* PRANCE (triangles).

elliptic to oblong elliptic, rounded to acute at apex, emarginate, subcuneate at base, glabrous beneath; petioles 1–3 mm long, *c.* 1.5 mm wide, lanate becoming glabrous with age, rugose. *Inflorescences* panicles of cymules, 3–4 cm long, the rachis and branches sparsely puberulous. *Flowers c.* 2 mm long. *Receptacle* campanulate, slightly swollen to one side, grey-tomentellous on exterior, tomentose within; pedicels *c.* 1 mm long. Calyx lobes acute, tomentellous on exterior, puberulous within. *Petals* puberulous on exterior. *Stamens* 7, inserted around complete circle, the filaments glabrous. *Ovary* inserted at base of receptacle, lanate-pilose, unilocular. *Fruit* (immature) ellipsoid, epicarp smooth, glabrous; mesocarp thin; endocarp thin, hard, bony, tomentose within, breaking open by longitudinal lines of weakness.

Distr. Malesia: Philippines (Palawan). Fig. 3.

Ecol. Confined to ultrabasic rock formation; 0–300 m altitude, including sea-shore forest.

3. **Licania fusicarpa** (KOSTERM.) PRANCE, Brittonia 39 (1987) 366. – *Hunga fusicarpa* KOSTERM. Reinwardtia 10 (1985) 123.

Tree to 7 m tall, young branches puberulous, glabrescent, with small prominent round lenticels. *Stipules* not seen. *Leaves* 5–10 by 1–4.5 cm, chartaceous, oblong to elliptic, acute to bluntly acuminate at apex, cuneate at base, glabrous and glossy on both surfaces, decurrent onto petiole; petioles 2–3 mm long, rugose, puberulous becoming glabrous with age. *Inflorescences* terminal and axillary panicles of cymules, few-flowered, the rachis and branches sparsely puberulous. *Flowers c.* 2 mm long. Receptacle campanulate, grey-tomentellous on exterior, tomentose within; pedicels 2–3 mm long. Calyx lobes acute, narrow, tomentellous on exterior, puberulous within. *Petals* not seen. *Stamens* persistent beneath young fruit, 0.5–1 mm long, connate at base. *Fruit* (2.5–)3–5 cm long, narrowly spindle-shaped, narrowed at apex to a tip 2–3 mm long, narrowed at base in stipe 5–10 mm long; epicarp smooth, glabrous; mesocarp thin; endocarp hard, bony, *c.* 1 mm thick, densely lanate within, without lines of dehiscence.

Distr. *Malesia*: E. Papua New Guinea (Milne Bay Prov., Ferguson I., Morobe Prov.). Fig. 5.

Ecol. Coastal rain-forest, 0–300 m altitude.

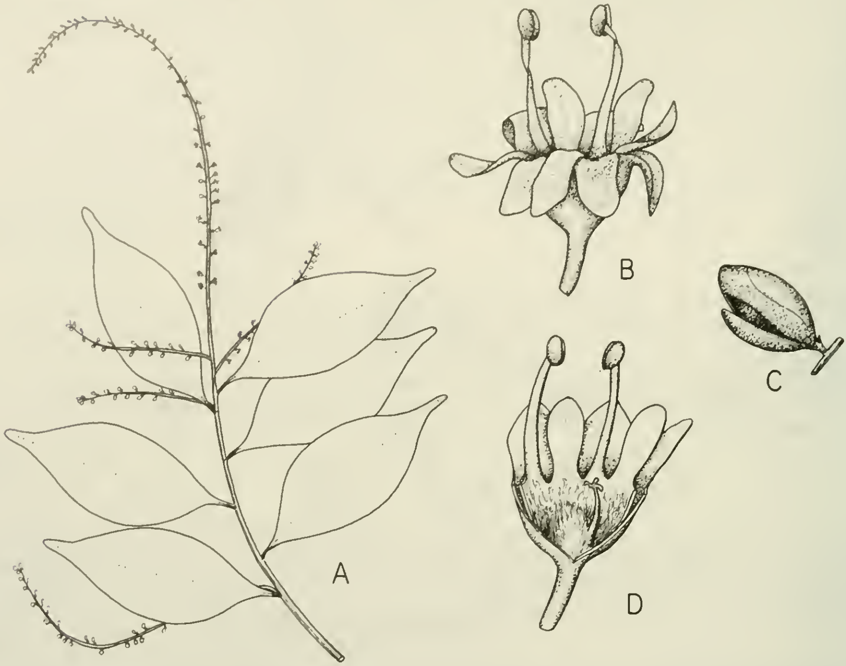

Fig. 4. *Parastemon urophyllus* (WALL. *ex* A.DC.) A.DC. *A*. Habit, ×0.5; *B*. flower, ×10; *C*. fruit, ×1; *D*. flower section, ×10 (*A, B* SINCLAIR 39504, *C, D* SINCLAIR 3319).

3. PARASTEMON

A.DC. Ann. Sci. Nat. Bot. sér. 2, 18 (1842) 208; MIQ. Fl. Ind. Bat. 1, 1 (1855) 359; HOOK. *f.* in Benth. & Hook. *f.*, Gen. Pl. 1 (1865) 607; Fl. Brit. India 2 (1878) 312; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 426; FOCKE in E. & P. Nat. Pfl. Fam. 3, 3 (1891) 60; MERR. Philip. J. Sc. 10 (1915) Bot. 307; RIDLEY, Fl. Mal. Pen. 1 (1922) 672; MERR. & PERRY, J. Arn. Arb. 21 (1940) 197; CORNER, Wayside Trees (1940) 526; HUTCH. Gen. Flow. Pl. 1 (1964) 193. – *Diemenia* KORTH. Ned. Kruidk. Arch. 3 (1854) 388; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 425. – *Trichocarya* MIQ. Fl. Ind. Bat. 1, 1 (1855) 357, *p.p.* – **Fig. 4.**

Tree or shrub. *Stipules* small and triangular, caducous. *Leaves* glabrous on both surfaces, without stomatal cavities, with 2 small discoid glands at base of lamina; petioles eglandular. *Inflorescence* an axillary or rarely terminal simple or sparsely branched raceme. Bracts and bracteoles small, eglandular, not enclosing groups of flower buds. *Flowers* hermaphrodite or polygamo-dioecious. *Receptacle* patelliform or shallowly cupuliform, shortly hairy within; calyx lobes 5, acute, subequal. *Petals* 5, not exceeding calyx lobes, not clawed. *Stamens* either 5 and all fertile or 2 fertile with 3 staminodes; the filaments glabrous, shorter than the calyx lobes. *Ovary* centrally inserted at base of receptacle, glabrous or densely hairy on exterior; carpel unilocular, with 2 ovules. *Style* filiform, puberulous towards the base, with 3 large undivided lobes at apex or 1 obscure lobe and 2 large, sometimes deeply divided lobes. *Fruit* a small drupe to *c.* 1.5 cm or *c.* 3 cm long; epicarp smooth, not lenticellate; endocarp thin, hard, bony, smooth on exterior, glabrous within; with 2 large lateral plates which break away on germination to allow seedling escape.

Distr. Three species; Nicobar Islands; in *Malesia*: Malay Peninsula, Sumatra, Borneo, Moluccas, New Guinea, Admiralty Is.

KEY TO THE SPECIES

1. Fruit 1–1.5 mm long. Primary veins of leaves 8–11 pairs.
   2. Receptacle shallowly cup-shaped, glabrous on exterior; fertile stamens 2; style 3-lobed at apex. Inflorescence glabrous .... **1. P. urophyllus**
   2. Receptacle saucer-shaped, puberulous on exterior; fertile stamens 5; style with one obscure and two large bifid apical lobes. Inflorescence villous .... **2. P. versteeghii**
1. Fruit 2.3–3.5 mm long. Primary veins of leaves 5–6 pairs .... **3. P. grandifructus**

1. Parastemon urophyllus (WALL. *ex* A.DC.) A.DC. Ann. Sci. Nat. Bot. sér. 2, 18 (1842) 208; MIQ. Fl. Ind. Bat. 1, 1 (1855) 359; BOERL. & KOORD. Ic. Bog. 1, 4 (1901) 61, t. 97; RIDLEY, Fl. Mal. Pen. 1 (1922) 672; BURK. Dict. (1935) 1693; CORNER, Wayside Trees (1940) 526; BROWNE, For. Trees Sarawak & Brunei (1955) 308; KOCHUM. & WYATT-SMITH, Mal. For. Rec. 17 (1964); PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 331. – *Embelia urophylla* [WALL. Cat. (1830) *n.* 2309, *nom. nud.*] *ex* A.DC. Trans. Linn. Soc. 17 (1837) 131. – *Diemenia racemosa* (KORTH.) MIQ. Fl. Ind. Bat. 1, 1 (1855) 358. – *Licania diemenia* BLUME, Mélang. Bot. 2 (1855) 10; HASSK. Flora 41 (1858) 256, *nom. illeg.* – *Parastemon spicatus* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 75 (1917) 29. – **Fig. 4.**

Tree to 40 m tall, or shrub, the young branches glabrous, the trunk often buttressed. *Stipules* triangular, *c.* 1 mm long, caducous. *Leaves* thinly coriaceous, narrowly oblong, 2.5–8 by 1.4–2.5 cm, cuspidate acuminate at apex, the tip 5–15 mm, cuneate at base; midrib plane above, prominulous beneath; primary veins 8–11 pairs; petioles 4–5 mm long, canaliculate, glabrous. *Inflorescence* of axillary and rarely terminal racemes or occasionally slightly branched, 4–14 cm long, the rachis glabrous. *Flowers* polygamo-dioecious, *c.* 1.5 mm long. *Receptacle* broadly cupuliform to flattened saucer-shaped, glabrous on exterior, tomentose within; pedicels up to 2 mm long. Calyx lobes acute, glabrous on exterior. Petals 5. *Stamens* 2 fertile and 3 sterile staminodes opposite. *Ovary* inserted at base of receptacle, pilose on exterior, unilocular. *Style* pilose at base, glabrous above, the stigma trifid. *Fruit* ellipsoid, 1–1.5 cm long; epicarp smooth, glabrous; mesocarp thin, hard; endocarp thin, hard, bony, glabrous within, opening by 2 lateral plates.

Distr. Nicobar Islands; in *Malesia*: Malay Peninsula, Sumatra, Borneo. Fig. 5.

Ecol. Characteristic of peat swamp forest where it is a common large tree, but wide ranging into shorter, more open scrub forest.

Uses. The wood is hard to use because of the silica content, but it is used locally for general construction, posts, and as firewood.

Vern. Malay Peninsula: *kelat, k. pasir, k. puteh, nylas*; Sumatra: *galam tabanga, kayu gelang, malas, meriawak*; Borneo: *mandailas*, Brunei, Besaya, *sempalawan*, Brunei, *tempalawan*, Bajau, *mengilas, ngilas padang, obah*, Sarawak.

Notes. The only record of this species from Java (BLUME *s.n.*, L) is very dubious since the collector's name was added later. It is probably either mislabelled or from cultivated material. The only difference given between *P. spicatus* and *P. urophyllus* is that the former is a shrub with sessile flowers. Some forms of *P. urophyllus* have extremely short pedicels and most sessile-flowered individuals are recorded as being small trees. There is thus no reason to maintain *P. spicatus* as a distinct species.

2. Parastemon versteeghii MERR. & PERRY, J. Arn. Arb. 21 (1940) 197.

Tree to 40 m tall, the young branches sparsely puberulous, soon glabrous. *Stipules* triangular, *c.* 1 mm long, caducous. *Leaves* thinly coriaceous, narrowly oblong, 5–9.5 by 1.8–3.7 cm, cuspidate acuminate at apex, the tip 7–15 mm long, cuneate at base; midrib plane above, prominulous beneath; primary veins 8–12 pairs, inconspicuous, slightly

Fig. 5. Distribution of *Licania fusicarpa* (KOSTERM.) PRANCE (diamond), *Parastemon urophyllus* (WALL. *ex* A.DC.) A.DC. (dots), *P. grandifructus* PRANCE (squares), and *P. versteeghii* MERR. & PERRY (triangles).

prominulous beneath; petioles 3–7 mm long, terete, glabrescent. *Inflorescence* of axillary and terminal racemes, 2–9 cm long, the rachis sparsely villous. *Flowers* hermaphrodite, *c.* 1.5 mm long; pedicels 1.5–3 mm, sparsely villous. *Receptacle* broadly cupuliform-flattened, sparsely villous on exterior, tomentose within. Calyx lobes acute, with hirsute margins. Petals 5, with hirsute margins. *Stamens* 5, all fertile, opposite the petals in a complete circle. *Ovary* inserted at base of receptacle, glabrous on exterior except at base, unilocular. *Style* pilose at base, glabrous above, the stigma with two large apical lobes, the third reduced or missing. *Fruit* ellipsoid, *c.* 1.6 cm long; epicarp smooth, glabrous; mesocarp thin, hard; endocarp thin, hard, bony, glabrous within, opening by two lateral plates.

Distr. *Malesia*: Moluccas (Morotai), New Guinea, and Admiralty Is. Fig. 5.

Ecol. Usually in well-drained hill forest up to 700 m altitude, but also reported from secondary forest, swampy (*Campnosperma*) forest and even beach forest.

Vern. New Guinea: *mangu*, Tobelo, *noeng*, Irian, *gorsauw*, Tor, *gwarsau*, Wainlag, *sirebo, sisero*, Kemtoek, *sosopi*, Japen, *telek*, Mooi, *sinoree*, Biak.

3. Parastemon grandifructus PRANCE, Brittonia 39 (1987) 366.

Tree to 30 m tall, the young branches glabrous, the trunk lightly buttressed to 1 m. *Stipules* caducous (not seen). *Leaves* coriaceous, narrowly oblong, 5–8.5 by 1.8–3.2 cm, with long cuspidate acumen at apex, the tip 10–16 mm long, cuneate at base, glabrous on both surfaces; midrib prominent above, prominulous or plane beneath; primary veins 5–6 pairs, prominulous above, plane beneath; petioles 5–8 mm long, glabrous, slightly canaliculate, slightly swollen at base. *Inflorescence* of axillary and terminal racemes, the rachis glabrous. *Flowers* seen only in fruiting specimens. Calyx lobes 5, acute, glabrous on exterior, glabrous within except for a few hairs around base. *Receptacle* glabrous on exterior in fruiting condition. *Style* persistent below fruits, the stigma bifid or trifid. *Fruit* ellipsoid, 2.3–3.5 by 1.3–1.5 cm, epicarp smooth, glabrous; mesocarp thin, 0.25 mm; endocarp thin, hard, bony, 0.25 mm thick, glabrous within, opening by 2 lateral plates 1.9–2 cm long.

Distr. *Malesia*: Borneo (Sarawak, Sabah). Fig. 5.

Ecol. Upland white sand areas.

Vern. Borneo: *ngilas*, Iban, *praus*, Dyak.

4. HUNGA

PANCHER *ex* PRANCE, Brittonia 31 (1979) 79; Fl. Nouv. Caléd. et Dép. 12 (1983) 106. – **Fig. 6, 8.**

Shrubs or small trees. *Stipules* lanceolate and persistent (absent or very early caducous in New Caledonian species). *Leaves* usually glabrous on both surfaces (lanate beneath in some New Caledonian species), with a pair of, often obscure, marginal glands towards the base, without stomatal cavities; petioles eglandular. *Inflorescence* a few-flowered terminal or axially raceme of cymules. Bracts and bracteoles small, persistent, not enclosing the flowers in small groups. *Flowers* hermaphrodite, slightly zygomorphic. *Receptacle* campanulate, slightly asymmetric, shortly puberulous on exterior, densely pubescent within. Calyx lobes 5, acute. Petals 5, small, not exceeding calyx lobes, not clawed. *Stamens* 5–9, not exceeding calyx lobes, unilateral with 3–7 staminodes opposite. *Ovary* inserted midway up receptacle, densely hairy on exterior; carpel bilocular with one ovule in each loculus. *Style* truncate but distinctly 3-lobed at apex. *Fruit* small, fleshy, bilocular or often with one loculus underdeveloped; epicarp smooth, not ridged, not lenticellate; mesocarp thin, fleshy; endocarp thin, hard, bony, with a smooth surface, interior very hairy, with 4–6 longitudinal lines of weakness which allow the seedling to escape.

Distr. There are 11 species, 8 of which occur in New Caledonia and the Loyalty Is., 3 in *Malesia*: Papua New Guinea.

KEY TO THE SPECIES

1. Inflorescence branches glabrescent; flowers glabrescent on exterior. Leaves with conspicuous anastomosing venation, oblong-elliptic to elliptic, 4–8.5 cm broad.
   2. Leaves elliptic, 7.5–8.5 cm broad .... **1. H. novoguineensis**
   2. Leaves oblong-elliptic, 4–6.5 cm broad .... **2. H. papuana**
1. Inflorescence branches lanate to puberulous; flowers pubescent on exterior. Leaf with venation not conspicuously anastomosing, oblong-lanceolate, 2–3.7 cm broad .... **3. H. longifolia**

1. Hunga novoguineensis PRANCE, Brittonia 31 (1979) 88. – **Fig. 6 G, H.**

Tree 4 m tall, the young branches puberulous, soon glabrous, lenticellate. *Stipules* lanceolate, puberulous, *c.* 5 mm long, persistent. *Leaves* coriaceous, elliptic, 15–19 by 7.5–8.5 cm, glabrous on both surfaces, apex acuminate, the acumen 8–10 mm long, subcuneate at base; primary veins 11–14 pairs, anastomosing 4 mm away from margins, prominulous above, prominent beneath; petioles 5–6 mm long, puberulous soon becoming glabrous, slightly canaliculate, eglandular. *Inflorescence* of terminal and axillary panicles, the rachis and branches puberulous. Bracts and bracteoles 1–2 mm long, puberulous, persistent. *Flowers* not seen. *Fruit* sagittate pyriform, *c.* 3.5 cm long, the upper part triangular, 2–2.5 cm long, the base with a stipe 6–10 mm long; epicarp glabrous, smooth, mesocarp thin, fleshy; endocarp thin, hard, bony, lanate within.

Distr. *Malesia*: Papua New Guinea, two collections, from Morobe and Milne Bay Prov. Fig. 7.

Ecol. Oak forest on slopes, at *c.* 800 m altitude.

2. Hunga papuana (BAKER *f.*) PRANCE, Brittonia 31 (1979) 88. – *Angelesia papuana* BAKER *f.* J. Bot. 61, Suppl. (1923) 13. – **Fig. 6 A–F.**

Small tree, the young branches lanate, soon glabrous. *Stipules* lanceolate, 3–6 mm long, puberulous, persistent. *Leaves* coriaceous, oblong-elliptic, 10–19 by 4–6.5 cm, finely acuminate at apex, the tip 8–16 mm, rounded to subcuneate at base, glabrous on both surfaces; primary veins 9–13 pairs, prominulous above, prominent beneath, conspicuously anastomosing 5 mm from margin; petioles 2–4 mm long, shallowly canaliculate, sparsely puberulous when young, soon glabrescent, rugose. *Inflorescences* of terminal and axillary panicles, 3–10 cm long, the rachis and branches sparsely lanate-puberulous when young. Bracts and bracteoles 0.5–2 mm long, sparsely puberulous-glabrescent on both surfaces. *Flowers* 1.5–2 mm long. *Receptacle* campanulate, glabrous externally, tomentose within. Calyx lobes glabrous on both faces except for ciliolate margins. *Petals* glabrous. *Stamens c.* 7, unilateral with toothed staminodes opposite. *Ovary*

Fig. 6. *Hunga papuana* (BAKER *f.*) PRANCE. *A*. Habit, ×0.5; *B*. flower, ×7; *C*. flower section, ×9; *D*. petal, ×15; *E*. fruit, ×0.5; *F*. ovary section, ×15. – *H. novoguineensis* PRANCE. *G*. Young fruit section, ×1; *H*. habit, ×0.5 (*A–C* FORBES 504, *D–F* WOMERSLEY NGF 19307, *G, H* HARTLEY 12645).

Fig. 7. Distribution of *Hunga longifolia* PRANCE (star), *H. novoguineensis* PRANCE (dots), and *H. papuana* (BAKER *f.*) PRANCE (triangles).

bilocular, lanate-pilose externally. *Style* pilose at base, glabrous above, stigma truncate. *Fruit* sagittate-pyriform, unilocular, to 5 cm long, the upper portion triangular, 2–3.5 cm long, the base narrowly and abruptly tapered to a stipe 0.6–1 cm long; epicarp smooth, glabrous; mesocarp thin, fleshy; endocarp thin, hard, bony, lanate-tomentose within.

Distr. *Malesia*: Papua New Guinea. Fig. 7.

Ecol. Oak forest; 500–1000 m altitude.

3. Hunga longifolia PRANCE, Brittonia 31 (1979) 84. – **Fig. 8.**

Tree 15 m tall, the young branches puberulous, soon glabrous. *Stipules* linear-lanceolate, 5–6.5 mm long, puberulous, subpersistent. *Leaves* coriaceous, oblong-lanceolate, 7–13 by 2–3.7 cm, acute to bluntly acuminate at apex, cuneate at base, glabrous on both surfaces; petioles 3–5 mm long, shallowly canaliculate, lanate when young, glabrescent with

Fig. 8. *Hunga longifolia* PRANCE. *A*. Habit, ×0.5; *B*. flower; *C*. petal; *D*. ovary section, all ×20.

age, slightly rugose. *Inflorescences* axillary and terminal panicles of cymules 1.5–6 cm long, the rachis and branches appressed lanate when young, becoming puberulous. Bracts and bracteoles 1–3.5 mm long, sparsely puberulous-glabrescent on both surfaces. *Flowers* 2–2.5 mm long. *Receptacle* campanulate, swollen slightly to one side, lanate-tomentose on exterior, tomentose within. Calyx lobes pubescent on both surfaces. *Petals* glabrous except for ciliate margins. *Stamens* 6–8, unilateral with 3–5 short staminodes opposite them. *Ovary* bilocular, inserted midway up receptacle tube, pilose on exterior. *Style* pilose at base. *Fruit* not seen.

Distr. *Malesia*: Papua New Guinea (Misima I.), known from a single collection. Fig. 7.

Ecol. Rain-forest on N. slope, at 300 m altitude. *Fl.* July.

5. PARINARI

AUBL. Hist. Pl. Guiane Fr. 1 (1775) 204; HAUMAN, Bull. Jard. Bot. Brux. 21 (1951) 184, q*uoad subg. Euparinari tantum*; BACKER & BAKH.*f.* Fl. Java 1 (1964) 521, *p.p.*; HUTCH. Gen. Flow. Pl. 1 (1964) 192, *p.p. excl. syn. Maranthes etc.*; KOSTERM. Reinwardtia 7 (1965) 7, *excl. syn. Thelira, Ferolia, Mampata et Neou*; PRANCE, Fl. Neotrop. 9 (1972) 178; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 332; WHITE, Bull. Jard. Bot. Nat. Belg. 46 (1976) 310; Distr. Pl. Afr. 10 (1976) 327; Fl. Zamb. 4 (1978) 36; PRANCE, Fl. Venez. 4 (1982) 325; SMITH, Fl. Vit. Nov. 3 (1985) 44. – *Dugortia* SCOP. Introd. (1777) 217, *nom. illeg.* – *Parinarium* JUSS. Gen. Pl. (1789) 342; LAMK, Encycl. Méth. Bot. 5 (1804) 17; ST.HIL. Expos. Fam. 2 (1804) 194, *p.p.*; R.BR. in Tuckey, Nar. Exped. Riv. Zaire Cong. (1818) 433; STEUD. Nom. (1821) 591; DC. Prod. 2 (1825) 526; POIR. Dict. Sci. 37 (1825) 544; BARTL. Ord. Nat. (1830) 406; G.DON, Gen. Syst. 2 (1832) 478; MEISSN. Gen. (1836/42) 102; BENTH. Hook. J. Bot. 2 (1840) 211, 218; ENDL. Gen. (1840) 1252, *n.* 6411; BENTH. in HOOK., Niger Fl. (1849) 333; MIQ. Stirp. Surin. Select. 2 (1850) 7; BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 94; Mélang. Bot. 2 (1855) 10; MIQ. Fl. Ind. Bat. 1, 1 (1855) 352; *ibid.* (1858) 1084; C.MUELL. in Walp., Ann. 4 (1857) 644; MIQ. Suppl. Sumatra (1860) 306; BENTH. Fl. Austr. 2 (1864) 426; HOOK. *f.* in Benth. & Hook.*f.*, Gen. Pl. 1 (1865) 607; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 237; HOOK. *f.* in Mart., Fl. Bras. 14 (2) (1867) 49; BAILL. Hist. Pl. 2 (1869) 435, 482; KURZ, For. Fl. Burma 1 (1877) 432; HOOK.*f.* Fl. Brit. India 2 (1878) 308; FRITSCH, Ann. Naturh. Mus. Wien 4 (1889) 33; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 421, 424; FOCKE in E. & P. Nat. Pfl. Fam. 3, 3 (1891) 60; KING, J. As. Soc. Beng. 66 (1897) 276; K. & V. Bijdr. 5 (1900) 332; BAILEY, Queensl. Fl. 2 (1900) 524; BRANDIS, Indian Trees (1906) 278; BACKER, Schoolfl. Java 1 (1911) 445; RIDLEY, Fl. Mal. Pen. 1 (1922) 666; MERR. Enum. Philip. Flow. Pl. 2 (1923) 235; BURK. Dict. (1935) 1693; CORNER, Wayside Trees (1940) 527. – *Petrocarya* SCHREB. in Linn. Gen. Pl. ed. 8, 1 (1789) 245, *nom. superfl.* – *Parinarium sect. Petrocarya* DC. Prod. 2 (1825) 526; BENTH. in Hook., Niger Fl. (1849) 335, *p.p. excl. P. glaberrima et P. scabra.* – *Parinarium sect. Neocarya* DC. Prod. 2 (1825) 526, *p.p. quoad P. excelsum.* – *Balantium* DESV. *ex* BUCH.-HAM. Prod. Pl. Ind. Occ. (1825) 34. – *Parinarium subg. Petrocarya* (DC.) MIQ. Fl. Ind. Bat. 1, 1 (1855) 352. –

Lepidocarpa KORTH. Ned. Kruidk. Arch. 3 (1854) 385. – *Ferolia* O.KUNTZE, Rev. Gen. Pl. 1 (1891) 216, *p.p. (non Ferolia* AUBL.). – **Fig. 15.**

Small or large trees or rarely shrubs. *Stipules* small to large, persistent or caducous. *Leaves* usually with stomatal crypts filled with pubescence on lower surface or rarely glabrous, or lanate pubescent without crypts. Petioles usually with 2 circular glands above. *Inflorescence* a many-flowered complex cyme or cymose panicle. Bracts and bracteoles eglandular, usually concealing flower buds individually and in small groups. *Flowers* hermaphrodite. *Receptacle* subcampulate to cupuliform, slightly swollen to one side, tomentose on both surfaces; calyx lobes 5, deltate, acute, densely hairy on both surfaces. *Petals* 5, as long as or shorter than sepals, caducous. *Stamens* 6–10, unilateral, the filaments glabrous, included, with *c.* 6 minute staminodes opposite. *Ovary* inserted on upper half of receptacle tube below mouth, pilose on exterior; carpel bilocular with 1 ovule in each loculus; style arcuate, included. *Fruit* a fleshy drupe; epicarp verrucose; endocarp thick, with a rough fibrous surface, with 2 basal obturators for seedling escape.

Distr. Pantropical with 18 species in the Neotropics, 6 in Africa and 15 in tropical Asia (*P. anamensis*), Malesia, the Pacific region (*P. insularam*) and northern Queensland, Australia; in *Malesia* 13 species.

Uses. The fruit of several species are edible, but little-used.

Note. Since inflorescences and flowers are uniform in the Malesian region, the species are difficult to separate; a key containing all 15 Australasian species, based on leaf characters only, is given here.

KEY TO THE SPECIES

1. Stomatal crypts absent from leaf underside; leaf underside glabrous or with a persistent lanate pubescence and then with large persistent stipules 7–40 mm.
 2. Leaf undersurface glabrous. Stipules small and caducous.
  3. Leaves elliptic to oblong or obovate-elliptic, 9.5–20.5 by 4.5–8.5 cm; primary veins 11–16 pairs. Panicles large and silvery pubescent .... **1. P. argenteo-sericea**
  3. Leaves ovate, 5–9 by 2–4.5 cm; primary veins 7–11 pairs. Panicles small and subsericeous brown pubescent .... **2. P. canarioides**
 2. Leaf undersurface densely lanate pubescent, but when removed no stomatal crypts present; stipules large and persistent, 7–40 mm long, 3–5 cm broad at base.
  4. Leaves oblong-lanceolate, 5–18 cm long on flowering branches, thickly coriaceous, base cuneate **3. P. elmeri**
  4. Leaves elliptic to oblong, 11–28 cm long, chartaceous, base rounded .... **4. P. parva**
1. Stomatal crypts present on leaf underside; leaf undersurface lanate or at least pubescent in crypts; stipules usually small, or if larger then early caducous.
 5. Leaf lower surface with a series of small glands along lower part of margin. Calyx broadly cupuliform.
  6. Leaf apex acute or rounded but not acuminate; primary veins 10–17 pairs. Young branches with small, almost plane lenticels. Low tree of savanna, savanna forest and forest margins .... **5. P. nonda**
  6. Leaf apex acuminate, acumen 3–10 mm long; primary veins 16–22 pairs; young branches with extremely prominent large lenticels; large tree of rain-forest and hills .... **6. P. papuana**
 5. Leaf lower surface without marginal glands on lower part. Calyx usually campanulate.
  7. Primary leaf veins 20–33 pairs (16–26 pairs in *P. costata ssp. polyneura*).
   8. Petioles 9–17 mm long .... **7. P. oblongifolia**
   8. Petioles 3–6 mm long.
    9. Leaves chartaceous, primary veins prominulous above, 16–26 pairs **13c. P. costata** *ssp.* **polyneura**
    9. Leaves coriaceous, primary veins impressed for upper portion, 20–28 pairs .... **8. P. gigantea**

7. Primary leaf veins 20 pairs or fewer.
  10. Petioles 10–20 mm long; leaves with or without a metallic sheen above.
    11. Leaves with metallic sheen above; petioles 14–20 mm long; leaves 4–9 cm broad. Borneo **9. P. metallica**
    11. Leaves without metallic sheen; petioles 10–12 mm long; leaves 6.5–12 cm broad. New Guinea **10. P. prancei**
  10. Petioles 3–10 mm long; leaves without metallic sheen.
    12. Leaves rigidly coriaceous, often broadest well below mid point; midrib and often primary veins lightly impressed on upper surface .... **11. P. rigida**
    12. Leaves thinly coriaceous or chartaceous, usually broadest at or above middle (except in *P. insularum*); midrib and primary veins usually plane or prominulous.
      13. Leaves ovate, with long thin acumen, tapering from well below mid point; midrib impressed above. Plants of Pacific Islands (Fiji, Tonga, Samoa, Wallis Is.) .... **P. insularum**
      13. Leaves elliptic to oblong-lanceolate, tapering from middle or above; midrib usually plane or prominulous. Plants of Sunda shelf.
        14. Inflorescence predominantly axillary. Leaves broadly elliptic .... **12. P. sumatrana**
        14. Inflorescence terminal and subterminal. Leaves elliptic to narrowly oblong.
          15. Leaf apex rounded to acute. Thailand and Indochina .... **P. anamensis**
          15. Leaf apex acuminate. Burma, Malay Peninsula, Indonesia and the Philippines **13. P. costata**

1. Parinari argenteo-sericea KOSTERM. Reinwardtia 7 (1965) 47, f. 1; 158.

Trees to 35 m tall; the young branches glabrous, prominently lenticellate. *Stipules* lanceolate, to 8 mm long, tomentose on exterior, early caducous. *Leaves* chartaceous, oblong, elliptic to subovate-elliptic, 9.5–20.5 by 4.5–8.5 cm, glabrous on both surfaces, without stomatal cavities beneath, usually 2 glands beneath at base near junction with midrib, acute to shortly acuminate at apex, the tip 7–10 mm long, rounded at base; midrib lightly impressed above except near base, prominent beneath; primary veins 11–16 pairs, plane above, prominent beneath, erect-patent; petioles 5–9 mm long, eglandular, glabrous, rugulose. *Inflorescence* a lax, much branched, terminal panicle 9–15 cm long, the rachis and branches densely grey sericeous-tomentose; bracts and bracteoles ovate, acute, densely tomentellous on exterior, glabrous within except near apex, caducous. *Receptacle* campanulate, markedly gibbous, densely grey tomentellous on exterior, 2–3 mm long; pedicels 1–3 mm long. Calyx lobes 2–3 mm long, narrowly ovate, densely grey tomentose on exterior, tomentellous within. Petals spathulate, 2 mm long, caducous. Fertile *stamens* 7–8, base forming a conspicuous fused ring with opposite tooth-like staminodes. *Ovary* densely pilose. *Style* pilose, stigma truncate. *Fruit* ovoid, 7–8 by 4.5–5.5 cm, exocarp densely lenticellate; mesocarp thin, fleshy; endocarp extremely hard and thick (1–8 cm thick), woody, granular, and very irregularly ridged, with 2 small loculi in centre, densely lanate within.

Distr. *Malesia*: North Borneo (Sabah). Fig. 9.

Ecol. Hillside forest, to 100 m altitude; forest along rivers.

Vern. *Berangan*, Malay.

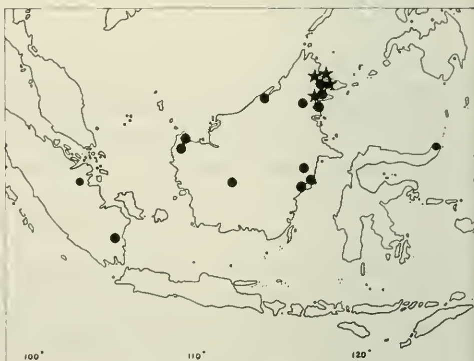

Fig. 9. Distribution of *Parinari argenteo-sericea* KOSTERM. (stars) and *P. canarioides* KOSTERM. (dots).

2. Parinari canarioides KOSTERM. New & Crit. Mal. Pl. 3 (1955) 25, t. 12 (For. Dept. Bur. of Planning, Bogor, Indonesia); Reinwardtia 7 (1965) 159, *f.* 2.

Trees to 60 m tall; trunk buttressed to 2.5 m high; young branches sparsely puberulous, glabrescent, lenticellate. *Stipules* linear, acute to 5 mm, hirsute, early caducous, present on very young leaves only. *Leaves* chartaceous, ovate, 5–9 by 2–4.3 cm, glabrous on both surfaces when mature, without stomatal crypts beneath, acuminate at apex, the tip 5–12 mm long, rounded to subcordate at base; midrib lightly impressed above, prominent beneath, sparsely pubescent when young; primary veins 7–11 pairs, plane to prominulous above, prominent beneath, arcuate; petioles 3–7 mm, glabrous when mature, eglandular or with small rather inconspicuous central glands. *Inflorescences* dense-flowered axillary panicles to 4.5 cm long, the rachis and branches tomentose; bracts and bracteoles persistent, ovate, puberulous on exterior, caducous. *Receptacle* campanulate, 3 mm long, tomentose on exterior; pedicels 1–2 mm long; calyx lobes elliptic, concave, *c.* 2 mm, acute, sparsely puberulous on exterior, densely tomentellous on interior. Petals elliptic, obtuse, 2 mm, tapered to base. Fertile *stamens* 7–8. *Fruit* ellipsoid, 3.5–5 by 1.5–2.5 cm; epicarp densely to sparsely lenticellate; mesocarp fleshy, 1 mm thick; endocarp 5 mm thick, hard, marbled, densely lanate within.

Distr. *Malesia*: Sumatra, Borneo, Sulawesi, Philippines (Palawan). Fig. 9.

Ecol. Forest extending up to 800 m altitude.

Uses. The timber is much used, but of poor quality. Fruit edible, also eaten by pigs.

3. Parinari elmeri MERR. Univ. Calif. Publ. Bot. 15 (1929) 92; KOSTERM. Reinwardtia 7 (1965) 161, f. 4; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 335.

Trees to 32 m, without buttresses; the young branches densely tomentellous, glabrescent, obscurely lenticellate. *Stipules* lanceolate, acute, to 18 mm long by 3 mm broad at base, lateral, tomentellous, persistent. *Leaves* oblong to oblong-lanceolate, 5–18 by 1.5–7 cm, chartaceous to thinly coriaceous, glabrous above, densely lanate pubescent beneath, without stomatal cavities; acuminate at apex, the tip 5–13 mm long, subcuneate at base; midrib plane or slightly impressed and pubescent above when young, prominent beneath; primary veins 14–21 pairs, prominent beneath, curved at margin; secondary nerves more or less parallel forming ladder-like reticulation; petioles 1.5–6 mm long, tomentellous, glandular, but glands often obscured. *Inflorescences* of raceme-like reduced terminal and axillary panicles or cymules, 1.7–3 cm long, the rachis and branches densely brown tomentose; bracts and bracteoles large, 2 mm long, ovate, persistent. *Receptacle* conical, gibbous, to 3 mm long, brown-lanate on exterior, pedicels 0.5–2 mm long. Calyx-lobes ovate, acute, 2–3 mm long, lanate on exterior. Petals white, oblong-ovate, 2–3 mm long, narrowed to base. Fertile *stamens* 7–9 with tooth-like staminodes opposite. *Fruit* oblong-ellipsoid, 6.7 by 3.7 cm; epicarp sparingly lenticellate.

Distr. *Malesia*: Malay Peninsula, Borneo (Sarawak, Brunei, Sabah, NE. Kalimantan), Philippines (Mindanao). Fig. 10.

Ecol. Lowland and hill forest to 900 m, including areas on ultrabasic rock.

Uses. The wood is used for supports of Iban long houses.

Vern. Borneo: *resak*, Iban.

Fig. 10. Distribution of *Parinari elmeri* MERR. (stars) and *P. parva* KOSTERM. (dots).

4. Parinari parva KOSTERM. Reinwardtia 7 (1965) 52, f. 5; 162; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 335.

Tree to 15 m tall, bole often fluted at base, without buttresses; the young branches densely tomentellous, glabrescent, conspicuously lenticellate. *Stipules* lanceolate, lateral, 13–37 mm long, up to 5 mm broad at base, persistent, conspicuously reticulate and densely tomentose on exterior. *Leaves* chartaceous, oblong to elliptic, 11–28 by 5.5–11 cm, glabrous above, densely lanate-arachnoid pubescent beneath, the pubescence completely obscuring reticulate nervation, but without stomatal crypts; finely acuminate at apex, the tip 3–13 mm long, rounded to subcordate at base; midrib plane and pubescent above, prominent beneath; primary veins 15–23 pairs, arcuate and anastomosing at margin, plane above, prominent beneath, pilose; petioles 5–8 mm, densely pale brown pilose, with 2–3 extremely prominent glands. *Inflorescence* of short little-branched terminal and axillary panicles to 5 cm long, sometimes borne on young woody branches, the rachis and branches densely pale-brown tomentellous; bracts and bracteoles ovate, acute, to 5 mm long, persistent. *Receptacle* campanulate, 3 mm long, pale brown tomentose on exterior; calyx lobes acute, ovate-lanceolate, 1–1.5 mm long, densely tomentose. Petals white. *Fruit* ellipsoid to narrowly ellipsoid, to 10 cm long by 3 cm broad; epicarp densely lenticellate, ridged when dry; mesocarp thin and fleshy; endocarp thick, hard.

Distr. *Malesia*: Malay Peninsula (Kelantan, Trengganu, Pahang, Johore), Sumatra, Borneo. Fig. 10.

Ecol. Mostly on ridge tops and hillsides to 750 m altitude.

5. Parinari nonda F.v.M. *ex* BENTH. Fl. Austr. 2 (1864) 426; BANKS & SOL. Bot. Cook's Voy. 1 (1900) t. 92; BAILEY, Queensl. Fl. 2 (1900) 524; Compreh Cat. Queensl. Pl. (1913) 167; PULLE, Nova Guinea, Bot. 8, 2 (1910) 367; KOSTERM. Reinwardtia 7 (1965) 170, f. 11a, *excl. syn. P. papuanum et P. salomonense*. – *Ferolia nonda* (F.v.M. *ex* BENTH.) O. KTZE, Rev. Gen. Pl. 1 (1891) 216.

Trees to 15 m tall, without buttresses, the young branches sparsely puberulous, soon glabrous, with small prominulous lenticels. *Stipules* lanceolate, membraneous, tomentellous, to 5 mm long, very early caducous. *Leaves* chartaceous to thinly coriaceous, oblong, 4–11 by 1.8–4.2 cm, glabrous above, with stomatal crypts filled with lanate pubescence beneath, rounded to acute (or rarely bluntly acuminate) at apex, subcuneate at base; midrib plane or prominulous, sparsely tomentellous when young above, prominent beneath; primary veins 10–17 pairs, curved at margins; secondary nerves reticulate slightly flattened, with a series of marginal glands at veins on lower portion; petioles 5–10 mm long, tomentellous, terete, with 2–4 prominent, conspicuous glands near mid point. *Inflorescence* of spreading terminal and subterminal panicles, 5–11 cm long, the rachis and branches rather sparsely grey-brown tomentellous; bracts and bracteoles large, ovate, 2.5–3 mm long, tomentose, caducous. *Receptacle* campanulate, 2–3 mm long, tomentose on exterior; pedicels 0.5–1 mm long. Calyx lobes triangular, acute, *c.* 1 mm long, tomentose on exterior, tomentellous within. Petals 5, white, acute. Fertile *stamens* 7–9, with tooth-like staminodes opposite, lanate around base. *Ovary* villous. *Style* villous lanate on lower portion, glabrous above; stigma capitate. *Fruit* ovoid, epicarp sparingly lenticellate.

Distr. Australia (Queensland and Northern Territory) and in *Malesia*: southern extreme of Papua New Guinea and Irian Jaya. Fig. 11.

Ecol. Savanna, open forest, forest on rocky areas in lowlands.

Vern. Papua New Guinea: *warrem*.

Fig. 11. Distribution of *Parinari nonda* F.v.M. *ex* BENTH.

6. Parinari papuana C.T.WHITE, J. Arn. Arb. 31 (1950) 86. – *Parinari nonda auct. non* BENTH.: KOSTERM. Reinwardtia 7 (1965) 170, *p.p.*

Large trees to 40 m tall, buttressed or unbuttressed, the young branches puberulous, soon glabrous, with clusters of large prominent lenticels with central slit. *Stipules* lanceolate, very early caducous. *Leaves* thickly coriaceous to chartaceous, oblong, 4–18 by 1.5–6.5 cm, glabrous above, with stomatal crypts filled with lanate pubescence beneath, acuminate at apex, the tip 3–10 mm long, rounded to subcuneate at base; midrib plane or slightly impressed and sparsely tomentellous when young above, prominent beneath; primary veins 16–22 pairs, curved and anastomosing at margins; secondary nerves reticulate, slightly flattened, with a series of marginal glands at vein endings on lower portion; petioles 2–8 mm long, tomentellous when young, terete or slightly canaliculate, with 2 conspicuous or sometimes obscure glands. *Inflorescence* of terminal and subterminal panicles, 2–6 cm long, the rachis and branches densely tomentose or tomentellous; bracts and bracteoles large, ovate, 2–2.5 mm long, tomentose on exterior; pedicels 0.2–1.5 mm long. Calyx lobes triangular, acute, *c.* 1 mm long, tomentose on exterior, tomentellous within. Petals 5, white, acute. Fertile *stamens* 7–8, with tooth-like staminodes opposite, lanate around base. *Ovary* villous, style villous on lower portion, glabrous above; stigma capitate. *Fruit* ovoid, 4–6 cm long; epicarp sparingly to densely lenticellate; mesocarp thin, fleshy; endocarp hard, thick, marbled, lanate within.

KEY TO THE SUBSPECIES

1. Leaves coriaceous, 4–11 by 1.9–5 cm. Mature fruit *c.* 6 cm long when dry. Montane . . . **a.** *ssp.* **papuana**
1. Leaves chartaceous, 7–18 by 2.5–7 cm. Lowland.
   2. Fruit sparsely lenticellate, small, *c.* 4 cm long. Leaf base subcuneate . . . . . **b.** *ssp.* **salomonense**
   2. Fruit densely lenticellate, large, *c.* 6.5 cm long. Leaf base usually rounded . . . . . . **c.** *ssp.* **whitei**

a. *ssp.* **papuana**

Unbuttressed tree. Leaves thickly coriaceous, 4–11 by 1.9–5 cm, subcuneate at base. Mature fruit *c.* 6 cm long when dry; densely lenticellate on exterior.

Distr. *Malesia*: Northern, Central and Eastern Papua New Guinea. Fig. 12.

Ecol. Mountains, 500–2000 m altitude. Fig. 12.

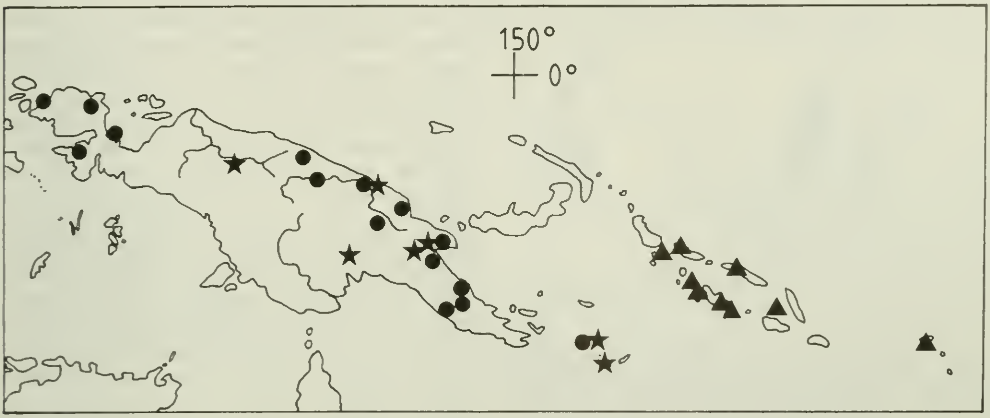

Fig. 12. Distribution of *Parinari papuana* C.T. WHITE *ssp. papuana* (dots), *ssp. salomonensis* (C.T. WHITE) PRANCE (triangles), and *ssp. whitei* PRANCE (stars).

Vern. *Korafe, morni*, Aiyura, *puwirini*, Waskuk, *Tor*, Anona.

b. *ssp.* **salomonense** (C.T.WHITE) PRANCE, Brittonia 39 (1987) 369. – *Parinari salomonense* C.T.WHITE, J. Arn. Arb. 31 (1950) 87.

Buttressed tree. Leaves chartaceous, 7–12 by 3–7 cm, subcuneate at base. Mature fruit *c.* 4 cm long, sparsely lenticellate on exterior.

Distr. Solomon Islands. Fig. 12.

Ecol. Lowland forest, hillsides and ridges to 300 m altitude.

Vern. *Malmone*, Kwara'ae, *nakisi, one one, sautalu, susui*.

c. *ssp.* **whitei** PRANCE, Brittonia 39 (1987) 369.

Unbuttressed tree. Leaves chartaceous, 7–18 by 2.5–6.5 cm, rounded at base. Mature fruit *c.* 6.5 cm long, densely lenticellate on exterior.

Distr. *Malesia*: West Irian and Papua New Guinea along northern coast from extreme west to east. Fig. 12.

Vern. *Lowka*, Manikiong, *ogelet*, Mooi.

7. **Parinari oblongifolia** HOOK. *f.* Fl. Brit. India 2 (1878) 309; KING, J. As. Soc. Beng. 66 (1897) 279; RIDLEY, Agr. Bull. Str. & Fed. Mal. St. 1 (1902) 144; Fl. Mal. Pen. 1 (1922) 668; Foxw. Mal. For. Rec. 3 (1927) 175; CORNER, Wayside Trees (1940) 527; KOSTERM. Reinwardtia 7 (1965) 165, *f.* 8; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 335. – *Ferolia oblongifolia* (HOOK.*f.*) O. Ktze, Rev. Gen. Pl. 1 (1891) 216. – *Parinarium borneense* MERR. Univ. Calif. Publ. Bot. 15 (1929) 93.

Trees to 40 m tall, trunk low thick buttressed to 2 m, the young branches minutely tomentellous, glabrescent, conspicuously prominently lenticellate. *Stipules* ovate to lanceolate, acute, 3–5 mm, pilose on exterior, early caducous. *Leaves* coriaceous, elliptic to oblong, 14–23 by 4–9 cm, glabrous above, with stomatal cavities filled with grey lanate pubescence beneath, shortly acuminate at apex, the tip 3–13 mm long, rounded to subcordate at base; midrib plane above, glabrous when mature except at base, prominent, glabrescent beneath; primary veins 23–35 pairs, erect, plane above, flattened and prominent beneath; secondary veins prominulous and parallel ± ladder-like beneath; petioles 9–17 mm long, thick, tomentellous, when young, glabrescent, eglandular or glandular. *Inflorescences* of large, spreading terminal panicles, 10–21 cm long by 7–12 cm broad, the rachis and branches yellow-grey tomentellous; bracts and bracteoles ovate, 3 mm long, early caducous. *Receptacle* campanulate, slightly gibbous, 3 mm long, densely grey tomentose on exterior; pedicels 1–3 mm long; calyx lobes ovate, acute, 1.5–2 mm long, unequal, grey tomentose. Petals white to bluish, lanceolate to spathulate, narrowed towards base, *c.* 2 mm long, glabrous. *Stamens* 8–10, with tooth-like staminodes opposite. *Ovary* pilose; style glabrous; stigma truncate. *Fruit* ellipsoid, 5–9 by 3–4 cm, epicarp densely lenticellate; mesocarp 1.5–2 mm thick; endocarp hard, thick, marbled, 7–13 mm thick, fibrous, densely lanate within.

Distr. *Malesia*: Malay Peninsula (S. Kelantan to Johore), Sumatra, Borneo (Sabah, Kalimantan). Fig. 13.

Ecol. Lowland rain-forest and beside rivers or in valleys extending to 450 m altitude.

Vern. Malay Peninsula: *bedara hutan, kemalau, mentelor, merbatu; dungun bukit*, Malay; Borneo: *mankudar, mengkudu*, Kalimantan.

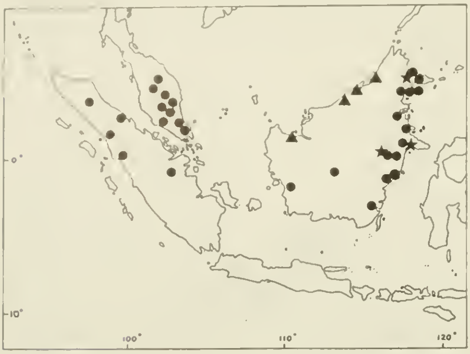

Fig. 13. Distribution of *Parinari oblongifolia* HOOK.*f.* (dots), *P. gigantea* KOSTERM. (stars), and *P. metallica* KOSTERM. (triangles).

8. Parinari gigantea KOSTERM. Reinwardtia 7 (1965) 182, f. 19.

Large trees to 40 m tall, trunk fluted at base, the young branches densely lanate pubescent, glabrescent, with conspicuous small lenticels. *Stipules* lanceolate, acute, to 25 mm long, caducous, membraneous, densely appressed tomentellous on exterior, glabrous within. *Leaves* coriaceous, elliptic, 9–17 by 5–8 cm, glabrous above, with dense conspicuous stomatal crypts beneath, bluntly acuminate at apex, the tip 3–6 mm long, rounded at base; midrib plane above, prominent and pilose, glabrescent beneath; primary veins 20–28 pairs, slightly impressed on upper portion, prominulous on lower portion of upper surface, straight, erect, parallel; secondary veins ± parallel; petiole thick, 4–7 mm long, tomentellous when young, with 2 small round glands on mid point above. *Flowers* not seen. *Infructescence* axillary, 3–5 mm long. *Fruit* irregularly ellipsoid, 6.5 cm long, 4 cm broad; epicarp densely lenticellate; mesocarp fleshy; endocarp hard, bony, irregularly ribbed, lanate within.

Distr. *Malesia*: Borneo (W. Kalimantan, Sabah). Fig. 13.

Ecol. Lowland forest.

Vern. *Lempong*, Kalimantan.

9. Parinari metallica KOSTERM. Reinwardtia 7 (1965) 49, f. 3; 160, f. 3.

Trees to 16 m tall, unbuttressed, the young branches appressed strigose, glabrescent, conspicuously lenticellate. *Stipules* ovate-lanceolate, acute, 8–15 mm long, densely brown tomentose, membraneous, early caducous. *Leaves* thickly coriaceous, elliptic, 8–17 by 4–9 cm, glabrous and shiny with metallic sheen above when dry, with dense stomatal crypts filled with hairs, apex rounded to shortly blunt acuminate, the tip 0–3 mm long, rounded or subcuneate at base; midrib plane above, prominent beneath; primary veins 10–15 pairs, prominulous to plane above, prominent beneath, erect, curved only at margin; petioles 14–20 mm long, glabrescent, with inconspicuous glands near to lamina base, puberulous, glabrescent. *Inflorescence* of axillary little-branched panicles, 4–10 cm long, the rachis and branches densely brown tomentellous; bracts and bracteoles ovate, early caducous. *Receptacle* campanulate, slightly gibbous, 2–3 mm long, ferrugineous pubescent on exterior; pedicels 0.5 mm long; calyx lobes lanceolate, acute, 1 mm long, tomentellous. Petals lanceolate, glabrous. *Stamens c.* 8 with short tooth-like staminodes opposite. *Ovary* densely pilose. *Style* glabrous, equalling stamens; stigma truncate. *Fruit* not seen.

Distr. Known only from Brunei, Sabah, and Sarawak. Fig. 13.

Ecol. Forests on well-drained soil, hillsides, 50–300 m altitude.

10. Parinari prancei KOSTERM. Reinwardtia 10 (1985) 124.

Trees to 25 m tall, the young branches densely brown lanate and pilose, lenticellate. *Stipules* caducous (not seen). *Leaves* rigidly coriaceous, elliptic, 9–21 by 6.5–12 cm, glabrous and shiny above when mature, lanate when young, with conspicuous stomatal crypts filled by lanate pubescence beneath, broadly apiculate at apex, rounded to broadly subcuneate at base; midrib ± plane above, prominent beneath; primary veins 14–16 pairs, plane or slightly impressed above, prominent beneath, arcuate near margins, secondary venation parallel and forming a ladder-like reticulum; petioles 10–12 mm long, densely ferrugineous lanuginose when young, eglandular. *Inflorescences* of axillary little branched small panicles or racemes, to 3 cm long, the rachis and branches densely appressed tomentellous; bracts and bracteoles caducous. *Receptacle* campanulate-cupuliform, 3–4 mm long, appressed tomentellous on exterior; pedicels 1.5 cm long; calyx lobes triangular, acute, 1.5 mm long, tomentellous. *Fruit* ellipsoid, *c.* 4 by 6 cm diam.; epicarp densely lenticellate; mesocarp fleshy, 2 mm thick; endocarp woody, very hard and thick, marbled, densely lanate within.

Distr. *Malesia*: E. Papua New Guinea (Milne Bay Prov., Northern Prov.). Fig. 14.

Ecol. Lowland rain-forest to 400 m altitude.

11. Parinari rigida KOSTERM. Reinwardtia 7 (1965) 53, f. 6a, b; 163. – *Parinari ashtonii* KOSTERM. Reinwardtia 7 (1965) 53, f. 7; 164.

Trees to 30 m tall, unbuttressed, the young branches tomentellous, glabrescent, inconspicuously lenticellate. *Stipules* caducous (not seen). *Leaves* rigidly coriaceous, elliptic to oblong ovate, 7.5–23 by 3–8

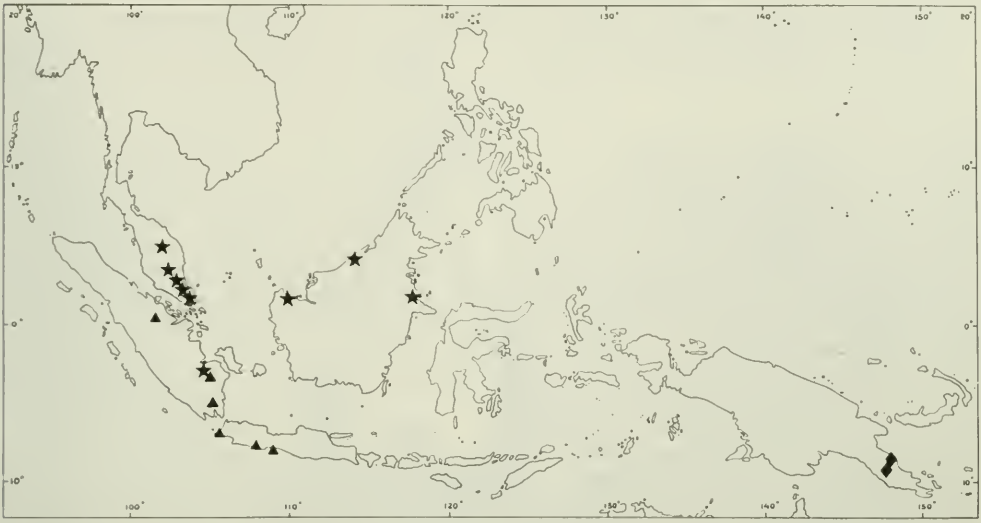

Fig. 14. Distribution of *Parinari prancei* KOSTERM. (diamonds), *P. rigida* KOSTERM. (stars), and *P. sumatrana* (JACK) BENTH. (triangles).

cm, those near to inflorescence much smaller than others, broadest below mid point, glabrous and shiny above, sometimes slightly bullate, the lower surface with stomatal crypts filled with pubescence, with 2 glandular areas at junction of midrib and petiole below, shortly and broadly acuminate at apex, the tip 3–17 mm long, rounded or subcordate at base; midrib plane or impressed for upper portion above, prominent and appressed pilose beneath when young; primary veins 13–20 pairs, slightly impressed above, prominent beneath, slightly curved at margins only; secondary venation flattened or rounded, parallel; petioles thick, 3–10 mm long, grey-pilose pubescent, rugose, with 2 small glands on mid point of upper side. *Inflorescences* of narrow terminal panicles to 13 cm long, the rachis and branches tomentose; bracts and bracteoles lanceolate, to 2 mm long, early caducous. *Receptacle* campanulate, slightly gibbous, 5 mm long, densely villous-tomentose on exterior; pedicels *c.* 1 mm long; calyx lobes elongate triangular, 2–2.5 mm long. Petals spathulate. *Stamens* 6–8. *Ovary* densely villous. *Style* equalling stamens; stigma capitate. *Fruit* irregularly ellipsoid, 5 cm long, to 4 cm diam., tapered towards base almost into a stipe; epicarp densely lenticellate; mesocarp thin fleshy; endocarp thick, woody, marbled, lanate within.

Distr. *Malesia*: S. Malay Peninsula, Sumatra, Borneo (Sarawak, E. Kalimantan). Fig. 14.

Ecol. Heath and swamp forests, lowland forest; 0–1400 m altitude.

12. Parinari sumatrana (JACK) BENTH. in Hook., Niger Fl. (1849) 335; BLUME, Mus. Bot.Lugd.-Bat. 2 (1852) 97; MIQ. Fl. Ind. Bat. 1, 1 (1855) 353; *ibid.* (1858) 1084; Suppl. Sumatra (1860) 115; *ibid.* (1861) 306; C.MUELL. in Walp., Ann. 4 (1857) 644; Flora 41 (1858) 255; HOOK. *f.* Fl. Brit. India 2 (1878) 309; MIERS, J. Linn. Soc. Bot. 17 (1879) 336; K. & V. Bijdr. 5 (1900) 340, *p.p. excl. P. costatum auct. non* BLUME; MERR. J. Arn. Arb. 33 (1952) 239; BACKER & BAKH.*f.* Fl. Java 1 (1964) 522, *p.p. excl. P. costatum*; KOSTERM. Reinwardtia 7 (1965) 176. – *Petrocarya sumatrana* JACK, Mal. Misc. 2 (7) (1822) 67 [repr. Calc. J. Nat. Hist. 4 (1843) 165]. – *Lepidocarpa ovalis* (KORTH.) BLUME *ex* MIQ. Fl. Ind. Bat. 1, 1 (1855) 353. – *Ferolia sumatrana* (JACK) O. KTZE, Rev. Gen. Pl. 1 (1891) 216. – *Parinarium auct. non* BLUME: BACKER, Schoolfl. Java 1 (1911) 445, *p.p.* – Fig. 15.

Trees to 30 m tall, without buttresses or small ones to 50 cm; the young branches densely tomentellous, glabrescent, lenticellate. *Stipules* oblong, to oblong-ovate, 5–12 mm long by 3–5 mm wide at base, membraneous, early caducous, pilose on exterior. *Leaves* chartaceous to subcoriaceous, elliptic to oblong elliptic, 7–14(–21) by 3–7.5 cm, obtuse to shortly broad acuminate at apex, the tip up to 3 mm long, rounded to subcordate at base; glabrous and shiny above, with deep-set stomatal crypts beneath obscured by dense caducous lanate pubescence when young; midrib plane to slightly impressed above, pilose towards base, prominent beneath; primary veins

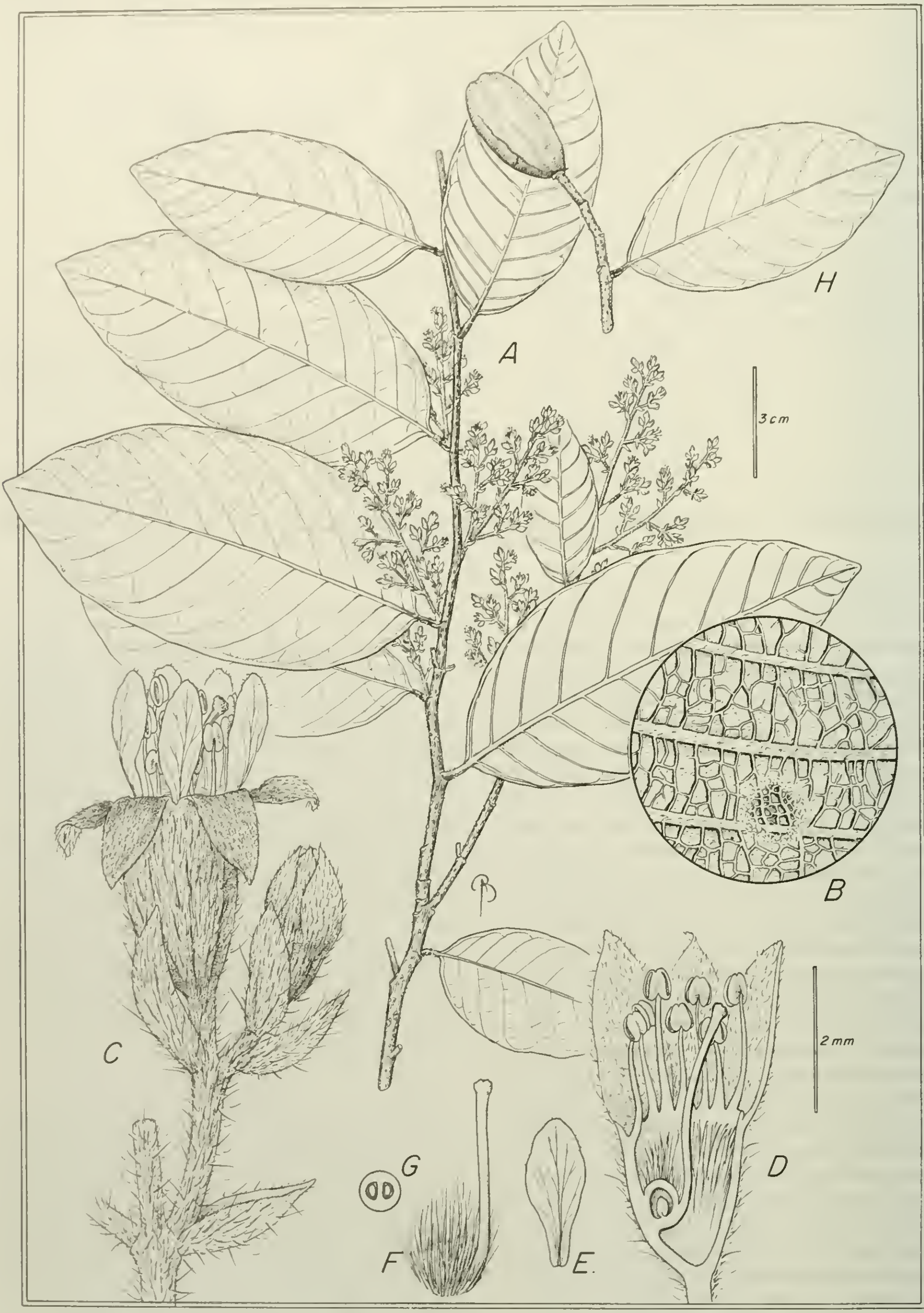

Fig. 15. *Parinari sumatrana* (JACK) BENTH. *A*. Habit; *B*. leaf undersurface with pubescence removed in small area to show stomatal cavities; *C*. flower; *D*. flower section; *E*. petal; *F*. ovary and style; *G*. ovary section; *H*. young fruit (KOSTERMANS 21859).

9–14 pairs, arcuate, prominulous above, prominent beneath; petioles 4–8 mm long, with 2 conspicuous glands near middle, lightly canaliculate, glabrescent. *Inflorescence* of short axillary panicles 2–6 cm long, the rachis and branches brown tomentose; bracts and bracteoles membraneous, tomentellous on exterior, puberulous within, caducous. *Receptacle* conical-campanulate, 3 mm long, densely pilose on exterior, almost sessile. Petals spathulate, bluish. Calyx lobes elongate-triangular, 2 mm long, acute, pilose on both surfaces. Fertile *stamens* 8, unequal. *Ovary* densely pilose. *Style* glabrous, equalling stamens, the stigma truncate. *Fruit* ellipsoid, 4 by 2.5 cm, epicarp densely lenticellate; mesocarp 3–4 mm thick; endocarp marbled in cross section, hard, 5 mm thick, densely lanate within.

Distr. *Malesia:* Sumatra, W. Java. Fig. 14.

Vern. Java: *kanjere badak.*

Note. This species is distinct from others by the predominantly axillary inflorescences. The material described as *Lepidocarpa ovalis* has much larger, more pointed leaves than most of the collections, but KOSTERMANS is correct in placing that name in synonymy under *P. sumatrana.*

13. Parinari costata (KORTH.) BLUME, Mélang. Bot. 2 (1855) 10; MIQ. Fl. Ind. Bat. 1, 1 (1855) 354; *ibid.* (1858) 1084; Suppl. Sumatra (1860) 115; C.MUELL. in Walp., Ann. 4 (1857) 644; Flora 41 (1858) 255; HOOK. *f.* Fl. Brit. India 2 (1878) 309; KING, J. As. Soc. Beng. 66 (1897) 277; RIDLEY, Agr. Bull. Str. & Fed. Mal. St. 1 (1902) 145; BRANDIS, Indian Trees (1906) 278; BURK. J. Str. Br. Roy. As. Soc. *n.* 73 (1916) 200; MERR. J. Str. Br. Roy. As. Soc. *n.* 76 (1917) 81; Enum. Born. Pl. (1921) 290; RIDLEY, Fl. Mal. Pen. 1 (1922) 666; MERR. Enum. Philip. Fl. Pl. 2 (1923) 236; BURK. Dict. (1935) 1667; HEYNE, Nutt. Pl. Ned. Ind. ed. 3 (1950) 697; KOSTERM. Reinwardtia 7 (1965) 179, f. 17a, b; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 333.

For further synonyms, see under the subspecies.

KEY TO THE SUBSPECIES

1. Inflorescence and flowers densely ferrugineous villous pubescent. Often at high altitudes ..... **b.** *ssp.* **rubiginosa**
1. Inflorescence and flowers sparsely to densely grey or brown appressed pubescent. Lowlands.
   2. Primary leaf veins 16–26 pairs; mature leaves 9–15.7 cm long, oblong (index 2.3–3.65). Fruit exocarp usually densely verrucose ..... **c.** *ssp.* **polyneura**
   2. Primary leaf veins 10–16 pairs; mature leaves 5–10.5 cm long, elliptic (index 1.7–2.7), rarely oblong. Fruit exocarp usually sparsely verrucose ..... **a.** *ssp.* **costata**

a. *ssp.* **costata.** – *Lepidocarpa costata* KORTH. Ned. Kruidk. Arch. 3 (1855) 387; MIQ. Fl. Ind. Bat. 1, 1 (1855) 354, *in syn., sphalm. Lepidocarya costata.* – *Ferolia costata* (KORTH.) O. KTZE, Rev. Gen. Pl. 1 (1891) 216.

Tree to 60 m tall, trunk buttressed up to 2 m, the young branches densely appressed tomentellous, glabrescent, with small conspicuous lenticels. *Stipules* lanceolate, membranaceous, 3–7 mm long, pilose on exterior, early caducous. *Leaves* coriaceous or rigidly chartaceous, elliptic, subovate-elliptic to oblong (leaf index 1.7–2.7), 5–10.5 by 1.8–4 cm, glabrous above when mature but with sparse lanate covering when very young, with stomatal cavities filled with grey lanate pubescence beneath, acuminate at apex, the tip 3–5 mm long, round to subcuneate at base; midrib prominulous above, tomentellous towards base, prominent beneath; primary veins 10–16 pairs, arcuate, prominulous above, prominent beneath; secondary veins rounded or only slightly flattened; petioles 5–9 mm long, slender, tomentellous when young, soon glabrous, usually eglandular or with 2 inconspicuous median glands. *Inflorescences* of predominantly axillary or terminal few-flowered lax panicles to 8 cm long, the rachis and branches appressed grey to brown appressed tomentellous; bracts and bracteoles lanceolate, *c.* 2 mm long, caducous. *Receptacle* campanulate, slightly gibbous, grey-brown pubescent on exterior, 3–3.5 mm long; pedicels 0.5–1 mm long; calyx lobes ovate, acute, 1.5–2 mm long, grey tomentellous on exterior. Petals white, spathulate, 1.5–2 mm long, caducous, glabrous. *Stamens* 7–8, with small tooth-like staminodes opposite, slightly unequal; style glabrous; stigma capitate. *Fruit* ellipsoid, to 3.5 by 4.5 cm; epicarp usually sparsely verrucose; mesocarp 2 mm, fleshy; endocarp hard, marbled, 3–5 mm thick, fibrous, densely lanate within.

Distr. *Malesia*: Malay Peninsula, Sumatra, Borneo, Philippines (Mindanao, Culion, Samar). Fig. 16.

Ecol. Lowland forest, hillsides, ridges; altitude up to 300 m.

Vern. Malay Peninsula: *kemalau, mambatu, merbatu*; Borneo: *augok*, Piak, *bugan*, Iban.

b. *ssp.* **rubiginosa** (RIDLEY) PRANCE, Brittonia 39 (1987) 368. – *Parinarium helferi* HOOK. *f.* Fl. Brit. India 2 (1878) 311, *excl. syn. Parinarium sumatranum sensu* KURZ; BRANDIS, Indian Trees (1906) 278; KOSTERM. Reinwardtia 7 (1965) 175. – *Parinari rubiginosa* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 75 (1917) 29; Fl. Mal. Pen. 1 (1922) 668; FOXW. Mal. For. Rec. 3 (1927) 175; BURK. Dict. (1935) 1667; KOSTERM. Reinwardtia 7 (1965) 168, f. 10; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 336. – *Parinarium costatum* BLUME *var. rubiginosum* RIDLEY, J. Fed.

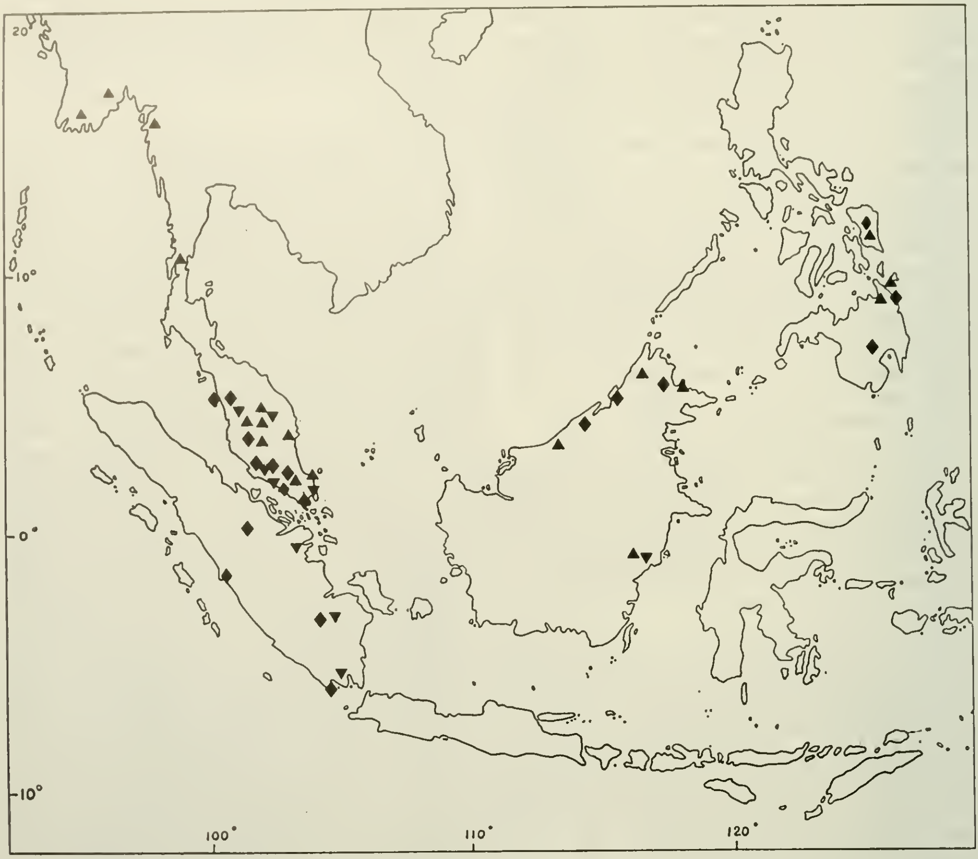

Fig. 16. Distribution of *Parinari costata* (KOSTERM.) BLUME (diamonds), *P. costcta ssp. rubiginosa* (RIDLEY) PRANCE (triangles), and *ssp. polyneura* (MIQ.) PRANCE (inverted triangles).

Mal. St. Mus. 6 (1915) 143. – *Parinari bicolor* MERR. Philip. J. Sc. 10 (1915) Bot. 309; Enum. Philip. Fl. Pl. 2 (1923) 235; KOSTERM. Reinwardtia 7 (1965) 172, *f.* 12.

Leaves 4–11.5 by 1.6–4.3 cm, oblong elliptic to oblong lanceolate; primary veins 11–19 pairs; petioles 4–8 mm long, thickly tomentose. *Inflorescence* dense to lax, ferrugineous villous pubescent. *Fruit* exocarp sparingly lenticellate.

Distr. Burma; *Malesia:* Malay Peninsula, Borneo (Sabah, Sarawak, Kalimantan), Philippines (Mindanao, Bucas Grande I.). Fig. 16.

Ecol. In lower montane forests of Malay Peninsula and Borneo (750–1500 m) and lowland forests of the Philippines.

Vern. *Merbatu*, Malay (= Malesian standard timber name for various genera); Borneo: *mengkudur*, Balikpapan.

c. *ssp.* **polyneura** (MIQ.) PRANCE, Brittonia 39 (1987) 368. – *Parinarium polyneurum* MIQ. Fl. Ind. Bat., Suppl. Sumatra (1860) 115; *ibid.* (1861) 306; HOOK. *f.* Fl. Brit. India 2 (1878) 309; KING, J. As. Soc. Beng. 60 (1897) 278; K. & V. Bijdr. 3 (1901) 340; KOSTERM. Reinwardtia 7 (1965) 167, f. 9a, b; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 336. – *Ferolia polyneura* (MIQ.) O. KTZE, Rev. Gen. Pl. 1 (1891) 216.

Leaves 9–15.7 by 3.7–6.3 cm, oblong (index 2.3 –3.65); primary veins 16–26 pairs; petioles 3–7 mm long, thick, tomentose. *Inflorescence* lax, inflorescence and flowers with grey appressed tomentellous pubescence. *Fruit* exocarp usually densely verrucose.

Distr. *Malesia*: Malay Peninsula (Kelantan, Perak, Pahang, Malacca), Singapore, Sumatra, Borneo. Fig. 16.

Ecol. Lowland forest and occasionally in hills and seasonal swamps.

Excluded species

Parinari wallichiana R.BR. [in Wall., Cat. (1832) 7520] *ex* HOOK. *f.* Fl. Brit. India 2 (1878) 311; KOSTERM. Reinwardtia 7 (1965) 178, *f.* 16. = *Dipterocarpus cornutus* DYER (*Dipterocarpaceae*).

6. ATUNA

RAFIN. Sylva Tellur. (1838) 153; KOSTERM. Reinwardtia 7 (1969) 421; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 323; SMITH, Fl. Vit. Nova 3 (1985) 47. – *Atunus* RUMPH. Herb. Amb. 1 (1741) 171, t. 66; LAMK, Encycl. Méth. 1 (1783) 329, *non Atunus* RUMPH. (1743); PANIGRAHI & PUROHIT, Taxon 32 (1983) 122. – *Cyclandrophora* HASSK. Flora 25^2, Beibl. 1 (1842) 47; STEEN. Bull. Jard. Bot. Btzg III, 17 (1948) 461; KOSTERM. Candollea 20 (1965) 118. – *Moquilea sect. Cyclandrophora* (HASSK.) ENDL. Gen. Pl. Suppl. 3 (1843) 103. – *Parinarium subg. Cyclandrophora* (HASSK.) BLUME, Mélang. Bot. 2 (1855) 10; repr. Flora N.R. 16 (1858) 255. – *Parinarium subg. Macrocarya* MIQ. Fl. Ind. Bat. 1, 1 (1855) 354. – *Parinarium sect. Cyclandrophora* (HASSK.) C.MUELL. in Walp., Ann. (1857) 644. – *Entosiphon* BEDD. Madr. J. Lit. Sci. ser. 3, 1 (1864) 44. – *Parinarium subg. III* HOOK. *f.* Fl. Brit. India 2 (1878) 308, *p.p.* – *Petrocarya auct. non* SCHREB.: JACK, Mal. Misc. 2 (7) (1822) 68 [repr. HOOK. Comp. Bot. Mag. 1 (1836) 220; Calc. J. Nat. Hist. 4 (1843) 164]. – *Parinari auct. non* AUBL. (*Parinarium auct. non* JUSS.): BENTH. in Hook., Niger Fl. (1849) 333, *p.p.*; BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 94; BENTH. in Benth. & Hook.*f.*, Gen. Pl. 1 (1865) 607; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 431, 424; FOCKE in E. & P. Nat. Pfl. Fam. 3, 3 (1891) 60; KOORD. Exk. Fl. Java 2 (1912) 338; RIDLEY, Fl. Mal. Pen. 1 (1922) 666. – **Fig. 19**.

Small to large trees, ultimate shoots with complicated system of divaricate branching. *Stipules* large, prominently keeled, lateral, persistent or subpersistent. *Leaves* almost glabrous on both surfaces, often with minute papillae on venation giving beaded appearance, without stomatal crypts, with a pair of glands on midrib at or near base of lower surface. Petioles eglandular. *Inflorescence* a raceme, or sparsely branched, contracted panicle. Bracts and bracteoles persistent, eglandular, not enclosing groups of flower buds. *Flowers* hermaphrodite. *Receptacle* obconical to cylindrical, as long as or exceeding calyx lobes, hollow, hairy inside throughout, throat blocked by retrorse hairs. Calyx lobes 5, broadly ovate to lanceolate, tomentellous on both surfaces. Petals 5, glabrous, exceeding calyx lobes. *Stamens* 10–20, posterior, inserted unilaterally on margin of disk; filaments free, exserted; staminodes forming a barely visible denticulate margin to throat. *Ovary* inserted at mouth of receptacle tube, pilose on exterior; carpel bilocular with 1 ovule in each loculus. *Fruit* large; epicarp glabrous, densely verrucose-crustaceous; mesocarp transversely fibrous; endocarp hard, thick, shortly and sparsely hairy inside, breaking up irregularly at germination. *Cotyledons* large and strongly ruminate. Germination cryptocotylar, eophylls alternate.

Distr. About 11 species in Southern India, Thailand, E. to Fiji and Samoa in the Pacific; in *Malesia* 5 species in the Malay Peninsula throughout Indonesia, and New Guinea.

Vern. *Merbatu*, Malay = Malesian standard timber name for various genera.

KEY TO THE SPECIES

(*including species of India and the Pacific*)

1. Leaf apex rounded; primary veins 6–8 pairs. *Fiji* .... **A. elliptica** (KOSTERM.) KOSTERM.
1. Leaf apex acuminate or acute; primary veins usually more than 10 pairs. *India, Malesia, or Pacific: Fiji, only A. racemosa.*
 2. Receptacle tube cylindrical and narrow.
  3. Leaves broadly elliptic, 8–10 cm broad; rounded at base; apex shortly acuminate, the acumen 2–3 mm long .... **1. A. latifrons**
  3. Leaves oblong, 2.5–6 cm broad; subcuneate to rounded at base; apex with long thin acumen 4–22 mm long.
   4. Receptacle 8–13 mm long. Leaf apex long acuminate; base rounded .... **2. A. nannodes**
   4. Receptacle 5–7 mm long. Leaf apex short acuminate, the acumen 3–10 mm long; base cuneate **3. A. penangiana**
 2. Receptacle tube funnel-shaped to campanulate.
  5. Leaves broadly ovate, thickly coriaceous, cordate at base, 4.5–12 cm long .... **4. A. cordata**
  5. Leaves usually elliptic, chartaceous to thinly coriaceous, usually rounded at base (if cordate then exceeding 10 cm in length).
   6. Fertile stamens 12–14. Inflorescence sericeous or sparsely pilose. *India.*
    7. Inflorescence sparsely pilose. Leaves elliptic-lanceolate, with 8–10 pairs of primary veins. *India* **A. indica** (BEDD.) KOSTERM.
    7. Inflorescence densely sericeous. Leaves lanceolate, with 12–16 pairs of primary veins. *India* **A. travancorica** (BEDD.) KOSTERM.
   6. Fertile stamens 15–20. Inflorescence tomentellous. Not in *India*.................. **5. A. racemosa**

1. Atuna latifrons (KOSTERM.) PRANCE & WHITE, Phil. Trans. Roy. Soc. Lond. 320 (1987) 132. – *Parinarium latifolium* HEND. Gard. Bull. Str. Settl. 7 (1933) 102, *nom. illeg.*, *non latifolium* EXELL. – *Parinari latifrons* KOSTERM. Reinwardtia 7 (1965) 54. – *Cyclandrophora latifolia* (HEND.) PRANCE in Kosterm., Candollea 20 (1965) 121. – *Atuna latifolia* (HEND.) KOSTERM. Reinwardtia 7 (1969) 421.

Small tree to 5 m tall, the young branches densely lanate-tomentellous becoming glabrous, obscurely lenticellate. *Stipules* lanceolate, to 11 mm long, acute, keeled, sparsely appressed pubescent. *Leaves* chartaceous, broadly elliptic, 11–13 by 8–10 cm, glabrous and shiny above, slightly bullate, glabrous beneath except for sparsely pilose venation, apex very shortly abrupt acuminate, the acumen 2–3 mm long, rounded at base with base contracted into petiole; midrib prominent on both surfaces, slightly pilose towards base above, pilose beneath; primary veins 12–14 pairs, prominulous inset in a groove above, prominent and pilose beneath, venation prominulous; petioles thick, 5–7 mm long, terete, densely brown lanate when young. *Inflorescences* of axillary little-branched panicles or spikes, to 5 cm long, densely brown sericeous; bracts and bracteoles to 15 mm long, ovate-lanceolate, acute, densely sericeous on exterior, appressed puberulous within. *Receptacle* tube narrowly cylindrical, 7–11 mm long, sericeous on exterior, sessile; calyx lobes lanceolate to oblong-ovate, 5–10 mm long, unequal, densely sericeous on exterior, tomentellous within. Petals obovate narrowed to base, 10–11 mm long. *Stamens* c. 20, inserted on faucal annulus 2 mm high with tooth-like staminodes opposite, the filaments 10–12 mm long. *Ovary* densely strigose. *Style* slender, glabrous; stigma truncate. *Fruit* unknown.

Distr. Known only from Malay Peninsula on Kedah-Perak border. Fig. 17.

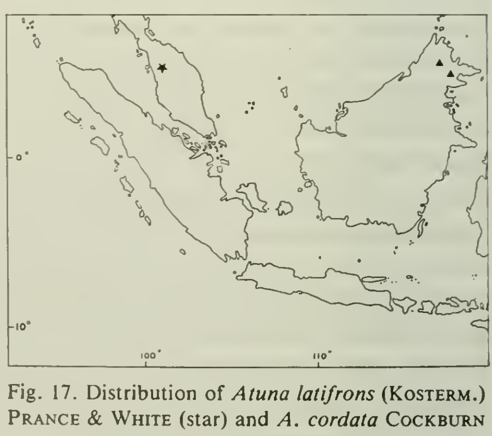

Fig. 17. Distribution of *Atuna latifrons* (KOSTERM.) PRANCE & WHITE (star) and *A. cordata* COCKBURN *ex* PRANCE (triangles).

2. **Atuna nannodes** (KOSTERM.) KOSTERM. Reinwardtia 7 (1969) 422; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 325. – *Parinari nannodes* KOSTERM. Reinwardtia 7 (1965) 50, f. 4. – *Cyclandrophora nannodes* (KOSTERM.) KOSTERM. & PRANCE, Candollea 20 (1965) 122.

Trees to 20 m, usually smaller, unbuttressed; the young branches sparsely appressed hirsutulous-strigose, soon glabrous, obscurely lenticellate. *Stipules* narrowly lanceolate, acute, 6–12 mm long, strigose to glabrous, subpersistent. *Leaves* thinly coriaceous, oblong-lanceolate, 6.7–19 by 2.5–5.5 cm, glabrous on both surfaces, sometimes slightly bullate above, long slender acuminate at apex, the acumen 7–22 mm long, rounded at base; midrib prominulous above, prominent beneath; primary veins 10–12 pairs, arcuate, prominulous on both surfaces or sometimes prominent beneath; petioles 2–4 mm long, glabrescent, eglandular, the lower part swollen, usually curved. *Inflorescences* axillary racemes 3–7 cm long, the rachis densely sericeous-tomentellous; bracts and bracteoles lanceolate, 3–7(–13) mm long, persistent, sericeous. *Receptacle* cylindrical, 8–13 mm long, densely sericeous on exterior, sessile; calyx lobes to 6 mm long, unequal, acute, sericeous on exterior. Petals white, spathulate to ovate, 8–12 mm long, narrowed to base. *Stamens* 18–20, black to purple, the filaments 10–15 mm long, slightly unilateral with tooth-like staminodes opposite. *Style* to 15 mm long, glabrous; stigma capitate. *Ovary* pilose. *Fruit* ellipsoid, 3–4 by 1.5 cm, slightly tapered to base, crustaceous verrucose on exterior; mesocarp 2–2.5 mm, fibrous, hard, endocarp thin.

Distr. *Malesia:* Malay Peninsula (Trengganu and Pahang southward), Borneo (Sabah, Sarawak). Fig. 18.

Ecol. Well drained forests to 500 m altitude.

Vern. *Merbatu*, Malay.

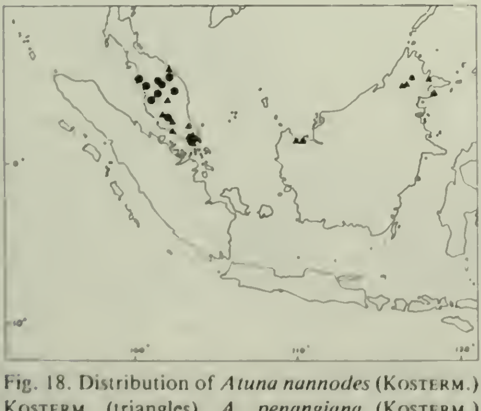

Fig. 18. Distribution of *Atuna nannodes* (KOSTERM.) KOSTERM. (triangles), *A. penangiana* (KOSTERM.) KOSTERM. (dots).

3. **Atuna penangiana** (KOSTERM.) KOSTERM. Reinwardtia 7 (1969) 422; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 326. – *Cyclandrophora penangiana* KOSTERM. & PRANCE, Candollea 20 (1965) 124. – *Parinari asperula auct. non* MIQ.: KING, J. As. Soc. Beng. 66 (1897) 281, *p.p.*

Trees to 20 m tall, unbuttressed, the young branchlets glabrescent, obscurely lenticellate. *Stipules* lanceolate, acute, to 7 mm long, glabrous, stiff, subpersistent. *Leaves* thinly subcoriaceous, oblong to oblong lanceolate, 3.7–13 by 2–5.5 cm, glabrous on both surfaces, acuminate at apex, the acumen 3–10 mm, cuneate at base; midrib flattened prominulous above, prominent beneath; primary veins 10–13 pairs, arcuate, prominulous on both surfaces; petioles 3–5 mm long, eglandular, glabrescent, smooth, not swollen or curved. *Inflorescences* axillary racemes 3–7 cm long, the rachis densely appressed pilose; bracts and bracteoles sericeous to 10 mm long, persistent. *Receptacle* cylindrical, 5–7 mm long, sericeous pubescent on exterior; calyx lobes acute, 4–5 mm long, slightly unequal. *Stamens c.* 20, the filaments to 8 mm long with tooth-like staminodes opposite. *Style* to 10 mm long, stigma capitate. *Ovary* pilose. *Fruit* (immature) ellipsoid, epicarp crustaceous, verrucose.

Distr. *Malesia:* Malay Peninsula (Penang, Perak, Johore, Kelantan and Trengganu). Fig. 18.

Ecol. Well drained forests to 500 m altitude.

Vern. *Membatu*, Malay.

Note. The two species *Atuna nannodes* and *A. penangiana* are hard to separate. The larger flowers of *A. nannodes* seem consistent and the species generally has leaves with a much longer apex. These may be one variable species.

4. **Atuna cordata** COCKBURN *ex* PRANCE, Brittonia 39 (1987) 364. – *Atuna cordata* COCKBURN, Trees of Sabah 2 (1980) 82, *nom. inval.*

Tree to 40 m tall, the trunk often with thick buttresses; young branches glabrescent, inconspicuously lenticellate. *Stipules* to 1.7 cm long, very early caducous. *Leaves* coriaceous, broadly ovate, 4.5–12 cm long, 3–9.5 cm wide, abruptly acuminate at apex, the acumen 1–3 mm long, cordate at base, glabrous and shiny above, glabrous beneath; midrib prominulous above, prominent beneath; primary veins 9–12 pairs, lightly prominulous above, prominulous and glabrous beneath; petioles 1–3 mm long, short and thick, glabrous. *Inflorescences* of terminal and subterminal racemes 4–8 cm long, borne in single or more often in paired branches, densely tomentellous on exterior, puberulous within; bracts and bracteoles ovate, tomentellous, early caducous. *Receptacle* 5–7 mm long, conical to campanulate, tomentellous on exterior, sessile; calyx lobes slightly unequal, tomentellous on both surfaces. Petals *c.* 7 mm long,

Fig. 19. *Atuna racemosa* RAFIN. *ssp. excelsa* (JACK) PRANCE. *A*. Habit; *B*. leaf undersurface; *C*. flower bud; *D*. flower section; *E*. ovary section; *F*. base of stamens; *G*. petal; *H*. fruit (*A–G* WHITMORE 3542, *H* AGAMA 4222).

bovate, glabrous. *Stamens c.* 10, inserted on one ide of ring, the filaments 10–12 mm long. *Ovary* lensely pilose. Style slender, hirsutulous on lower ortion. *Fruit* 6 cm long, 5 cm wide, ovoid; epicarp rustaceous verrucose, mesocarp 5 mm thick, fi-rous, hard, endocarp thin.

Distr. *Malesia:* Borneo (Sabah). **Fig. 17.**

Ecol. Hill forests on ultrabasic rock.

. **Atuna racemosa** RAFIN. Sylva Tellur. (1838) 153; IERR. Index Rafin. (1949) 136; KOSTERM. Reinward-ia 7 (1969) 422. – **Fig. 19.**

For further synonyms, see under the subspecies.

KEY TO THE SUBSPECIES

. Leaves 10–25(–35) cm long, usually elliptic, oblong or lanceolate but sometimes ovate, chartaceous or thickly coriaceous, the apex long finely acuminate, 6–25 mm long; petioles thick. Flowers 10–17 mm long. Medium to large trees often with fluted bole .... **a.** *ssp.* **racemosa**

. Leaves 4.5–12 cm long, usually ovate or oblong-ovate, subcoriaceous or coriaceous, the apex bluntly acuminate, 3–10 mm long; petioles thin. Flowers 8–11 mm long. Large trees with cylindrical bole .... **b.** *ssp.* **excelsa**

. *ssp.* **racemosa**. – *Atunus alba* RUMPH. Herb. mb. 1 (1741) 171, t. 66, *non Atunus litorea* RUMPH. Herb. Amb. 3 (1743) 96, t. 63. – *Cyclandrophora laberrima* HASSK. Flora 25 (2), Beibl. 1 (1842) 47; *bid.* 27 (1844) 583; Cat. Hort. Bog. (1844) 269. – *Parinari glaberrimum* (HASSK.) HASSK. Tijd. Nat. Ges. Phys. 10 (1843) 147; C.MUELL. in Walp., Rep. (1845/46) 647; in Walp., Ann. 4 (1857) 645; BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 98; MIQ. Fl. Ind. Bat. , 1 (1855) 355; K. & V. Bijdr. (1900) 338, *incl. var. anceolatum* (TEIJSM. & BINN.) K. & V., *p.p. quoad pec. Java*; BURK. Dict. (1935) 1696; BACKER & BAKH.*f.* Fl. Java 1 (1964) 522. – *Parinarium scabrum* HASSK. Tijd. Nat. Ges. Phys. 10 (1843) 147, *nomen*; Cat. Hort. Bog. (1844) 269, *nomen*; Flora 27 1844) 585; C.MUELL. in Walp., Rep. 5 (1845/46) 647; in Walp., Ann. 4 (1857) 645; BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 95, *p.p.*; MIQ. Fl. Ind. Bat. 1, 1 1855) 354, t. 5; K. & V. Bijdr. 5 (1900) 337, *p.p.*; BACKER, Schoolfl. Java (1911) 445; RIDLEY, Fl. Mal. Pen. 1 (1922) 669. – *Parinarium lanceolatum* TEIJSM. & BINN. Cat. Hort. Bog. (1854) 253, 255, *nomen*. – *Parinarium amboinense* TEIJSM. & BINN. *l.c.* 254, *nomen*. – *Parinarium margarata* A.GRAY, Bot. Wilkes U.S. Expl. Exped. 1 (1854) 489, t. 55; C.MUELL. in Walp., Ann. 4 (1857) 646. – *Parinarium laurinum* A.GRAY, Bot. Wilkes U.S. Expl. Exped. 1 (1854) 490, t. 55; C.MUELL. in Walp., Ann. 4 1857) 646; MERR. Philip. J. Sc. 10 (1915) Bot. 210; KANEHIRA, Bot. Mag. Tokyo 45 (1931) 282. – *Petrocarya glaberrima* (HASSK.) MIERS, J. Linn. Soc. Bot. 17 (1879) 336. – *Ferolia glaberrima* (HASSK.) O. Ktze, Rev. Gen. Pl. 1 (1891) 216. – *Ferolia scabra* (HASSK.) O. KTZE, *l.c.* 216. – *Petrocarya scabra* (HASSK.) MIERS, J. Linn. Soc. Bot. 17 (1897) 336. – *Parinarium elatum* KING, J. As. Soc. Beng. 66 (1897) 280; RIDLEY, Fl. Mal. Pen. 1 (1922) 669. – *Parinarium hahlii* WARB. Tropenpfl. 6 (1902) 370. – *Parinarium mindanaense* PERK. Fragm. Fl. Philip. (1904) 119. – *Parinarium curranii* MERR. Philip. J. Sc. 4 (1909) Bot. 264. – *Parinarium warburgii* PERK. *ex* MERR. J. Str. Br. Roy. As. Soc. *n.* 76 (1917) 82. – *Cyclandrophora elata* (KING) KOSTERM. Candollea 20 (1965) 122. – *Cyclandrophora scabra* (HASSK.) KOSTERM. *l.c.* 126. – *Cyclandrophora laurina* (GRAY) KOSTERM. *l.c.* 135. – *A. elata* (KING) KOSTERM. Reinwardtia 7 (1969) 421; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 324. – *Atuna scabra* (HASSK.) KOSTERM. Reinwardtia 7 (1969) 422.

Trees to 45 m tall, usually smaller, the bole often fluted, young branches glabrous or appressed strigose. *Stipules* lanceolate, stiff, to 20 mm long, acute, glabrous to strigose, subpersistent. *Leaves* usually chartaceous, more rarely stiffly coriaceous, broadly ovate, elliptic, oblong or even lanceolate, 10–25 (–35) by 3.5–11 cm, acuminate at apex, the acumen 6–25 mm long, rounded to subcordate at base, glabrous on both surfaces when mature, sometimes sparsely strigose beneath on lower portion when young; midrib prominent on both surfaces; primary veins 10–13 pairs, prominulous above, prominent beneath, straight or arcuate; the venation conspicuously papillose and often giving leaf a scabrous appearance; petioles thick, 3–7 mm long, glabrous or pilose glabrescent. *Inflorescences* of axillary racemes or little branched with up to 3 racemose branches on short main peduncle, 5–15 cm long, the rachis tomentellous to sericeous; bracts and bracteoles ovate, acute, to 8 mm long, caducous. *Receptacle* turbinate-campanulate, 5–10 mm long, tomentose to sericeous on exterior; pedicels 0.5–1 mm long, calyx lobes 4–7 mm long, ovate to ovate-oblong, densely tomentellous on both surfaces. Petals ovate-oblong, to 10 mm long, blue or white. *Stamens* 15–20, pale blue, to 15 mm long with tooth-like staminodes opposite. *Ovary* densely villous. *Style* equalling filaments, stigma small. *Fruit* ellipsoid to subglobose, to 7.5 cm diam.; epicarp crustaceous verrucose; mesocarp to 11 mm thick, endocarp thin, 1–3 mm, densely pilose within.

Distr. A wide range from Thailand to the Pacific: Admiralty, Caroline, and Solomon Islands, Fiji, Tonga, Samoa; in *Malesia*: Malay Peninsula (Perak), Singapore, Sumatra, Borneo (Sarawak, Brunei), Sulawesi, Philippines, Ambon, Ternate, Ceram, New Guinea, New Britain. Fig. 20.

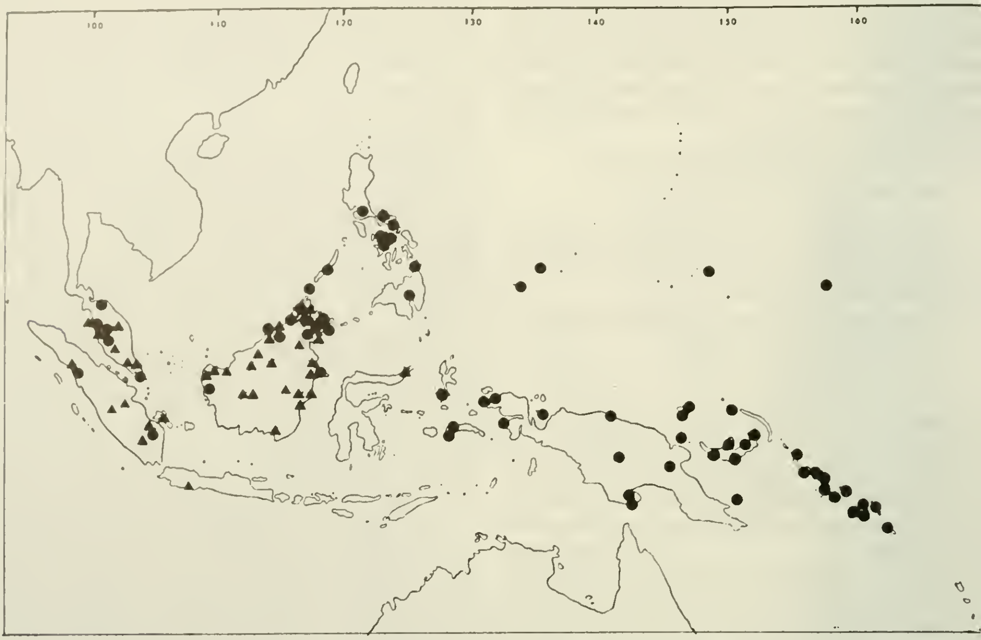

Fig. 20. Distribution of *Atuna racemosa* RAFIN. *ssp. racemosa* (dots) and *ssp. excelsa* (JACK) PRANC (triangles). *Atuna racemosa ssp. racemosa* also occurs in Tonga, Fiji, and Samoa outside the area shown i the map.

Ecol. Usually occurring in well-drained lowland or hill forest, up to 600 m altitude, but also found on riverbanks, freshwater or brackish swamps and even in mangrove.

Uses. The fruit (cotyledon) is grated and made into a putty for caulking canoes, widely used in Pacific islands. An oil is extracted from the seeds used variously in different areas, *e.g.* to scent coconut oil and for hairdressing. The leaves are used to thatch the outside walls of houses in Fiji. The wood is used locally for posts and poles, but is not of good quality.

Vern. *Jangong, membatu*, Malay; *kisokka*, Jav.; Borneo: *belibu, senumpol*, Iban, *kukut*, Sarawak, *merampangi, tatambu*, Sabah, *torog*, Orang Sungei, K'tangan; Sulawesi: *lomo*, Makassar; Philippines: *aluma*, Ceb., *botabon, butabul, getabon*, Tagb., *botga*, Bik., *pantog-usa*, Kuy., *pinae, tabontaba, takoutaban*, Bis., *tabong*, Bag., *tabon-tabon*, C. Bis., Bik., Mbo., *samake*, Bug.; New Guinea: *asikua, asista*, Saki, *bata-bata, koewao*, Kwerba, *dela*, Mooi, *kan*, Oriomo, *low tukwa, lowtukwa*, Manikiong, *mangosowai*, Japen; New Britain: *latita, tita*; New Georgia: *jij, tavai, tita*, Uso; Caroline Is.: *agaratim, ais, eis, eritem, grihing*, Palau, *adidi*, Yap, Solomon Is.: *do-omu, oso, saia, tij*, Kwara'ae; Fiji: *makita*; Tonga: *hea, seea*; Samoa: *ifi-ifi*.

Note. KOSTERMANS included *Cyclandrophoi glaberrima* as a synonym of *Atuna excelsa* rath than where it is placed here. There seems little doul based on the original description and herbariu material at Leiden bearing HASSKARL's writing th *C. glaberrima* is equal to *Atuna racemosa ssp. rac mosa* as defined here. The original description of (*glaberrima* indicates leaves that are far too large f *ssp. excelsa*. *Atuna excelsa* was distinguished t KOSTERMANS by its coriaceous leaves and short pe ioles. However, many sheets which he determined *A. racemosa* have equally short petioles and there much variation in leaf texture. Therefore it is n possible to maintain *A. elata*. Similarly the distin tion of *A. scabra* was the scabrous texture of tl leaves and their more lanceolate shape. Many colle tions of *A. racemosa* are equally scabrous (*e.g.* LA 52392 from New Guinea) and there is so much vari tion in leaf shape that it would be quite impossible t separate *A. scabra* on that feature. This was alread placed under *Parinari glaberrimum* by BACKER an BAKHUIZEN VAN DEN BRINK (*l.c.* 1964).

b. *ssp.* **excelsa** (JACK) PRANCE, *stat. nov.* – *Petroc rya excelsa* JACK, Mal. Misc. 2 (7) (1822) 68 [rep HOOK. Comp. Bot. Mag. 1 (1836) 220; Calc. J. Na Hist. 4 (1843) 164]; WALP. Rep. 2 (1843) 7. – *Parin* *rium jackianum* BENTH. in Hook., Niger Fl. (1849) 335; MIQ. Fl. Ind. Bat. 1, 1 (1855) 356; C.MUELL. in Walp., Ann. 4 (1857) 644; HOOK. *f.* Fl. Brit. India 2 (1878) 312. – *Parinarium asperulum* MIQ. Fl. Ind. Bat., Suppl. Sumatra (1860) 115, *nomen*; *ibid.* (1861) 307, *descr.*; HOOK. *f.* Fl. Brit. India 2 (1878) 310; KING, J. As. Soc. Beng. 66 (1897) 281; K. & V. Bijdr. (1900) 337, *p.p.*; RIDLEY, Fl. Mal. Pen. 1 (1922) 670. – *Ferolia asperula* (MIQ.) O. KTZE, Rev. Gen. Pl. 1 (1891) 216. – *Ferolia jackiana* (BENTH.) O. KTZE, *l.c.* – *Parinarium spicatum* KING, J. As. Soc. Beng. 66 (1897) 279; RIDLEY, Fl. Mal. Pen. 1 (1922) 669. – *Parinarium maingayi* KING, J. As. Soc. Beng. 66 (1897) 280; RIDLEY, Fl. Mal. Pen. 1 (1922) 669. – *Parinarium villamilii* MERR. Philip. J. Sc. 10 (1915) Bot. 308; Enum. Philip. Fl. Pl. 2 (1923) 236. – *Cyclandrophora villamilii* (MERR.) PRANCE *ex* KOSTERM. Candollea 20 (1965) 126. – *Cyclandrophora excelsa* (JACK) KOSTERM. *l.c.* 128. – *Cyclandrophora asperula* (MIQ.) PRANCE *ex* KOSTERM. *l.c.* 130. – *Atuna villamilii* (MERR.) KOSTERM. Reinwardtia 7 (1969) 422. – *Atuna excelsa* (JACK) KOSTERM. *l.c.* 422; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 324. – **Fig. 19.**

Tree to 45 m tall, the trunk buttressed up to 2 m, not fluted, the young branches sparsely strigose, glabrescent, obscurely lenticellate. *Stipules* lanceolate, 8–15 mm long, acute, sparsely strigose, subpersistent. *Leaves* rigidly chartaceous to coriaceous, ovate to oblong-ovate or less frequently oblong, 4.5–12 by 2–5 cm, acuminate at apex, the acumen 3–10 mm long, subcordate, rounded or subcuneate at base, glabrous on both surfaces; midrib prominent on both surfaces; primary veins 9–13 pairs, arcuate, prominulous above, prominent beneath, the venation papillose giving a beaded appearance; petioles slender, 3–6 mm long, puberulous, glabrescent or glabrous. *Inflorescences* of axillary racemes to 7.5 cm long, or little branched with 2 or more racemose branches on short main peduncle, the rachis and branches densely short sericeous; bracts and bracteoles oblong, *c.* 3 mm long, persistent. *Receptacle* turbinate-campanulate, 4–7 long, sericeous on exterior; calyx lobes ovate, equal, to 4 mm, sericeous on exterior, tomentellous within. Petals white to bluish white, oblong, to 5 mm long, caducous. *Stamens* 13–18, to 8 mm long with tooth-like staminodes opposite. *Ovary* pilose. *Style* glabrous, equalling filaments, glabrous above, stigma small. *Fruit* subglobose to slightly pyriform, 5–7 cm diam. or 5–7 by 3.5–4.5 cm; epicarp crustaceous, verrucose; mesocarp fibrous, 5–8 mm thick, endocarp thin, densely pilose within.

Distr. *Malesia*: Malay Peninsula (Kedah and Trengganu southward), Sumatra, Java, Borneo, N. Sulawesi. Fig. 20.

Ecol. Lowland forests on well drained soils extending to 750 m altitude on ridges and hillsides.

Vern. Malay Peninsula: *kemalau ulat, merbatu*; Sumatra: *kemiling utan, klappa soepai, pelec kambing, salak*; Borneo: *membatu*, Sabah, *mahadiu*, Bandjar, *temalang*.

Notes. KOSTERMANS is probably correct in interpreting *Petrocarya excelsa* JACK as the species described here. The original description is quite detailed and fits this taxon better than any other *Atuna*.

KOSTERMANS treated these two subspecies as separate species. They were differentiated by small characteristics of leaf shape, the acumen and the base. While there do seem to be two elements involved in this complex, there is a complete graduation of any single character such as leaf length, apex length, petiole thickness, leaf shape or flower size. *Ssp. excelsa* is much commoner in Sundaland and *ssp. racemosa* in the Sahul shelf and Pacific islands, but the two subspecies have considerable geographical overlap with *ssp. racemosa* occurring sporadically on the Malay Peninsula. Since all characters merge and are only weakly correlated, these two species are reduced to subspecies, a rank more in accord with their variational and geographical patterns.

7. MARANTHES

BLUME, Bijdr. (1825) 89; KOSTERM. Candollea 20 (1965) 196; PRANCE, Bol. Soc. Brot. sér. 2, 40 (1966) 183; Brittonia 20 (1968) 203; Fl. Neotrop. 9 (1972) 201; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 329; WHITE, Bull. Jard. Bot. Nat. Belg. 46 (1976) 294; Distr. Pl. Afr. 10 (1976) 313; Fl. Zamb. 4 (1978) 41; LETOUZEY & WHITE, Fl. Cameroun 20, Fl. Gab. 24 (1978) 29. – *Exitelia* BLUME, Fl. Jav. 1, Praef. (1828) vii, *nom. illeg.* – *Grymania* PRESL, Epim. Bot. (1851) 193, *p.p. quoad G. salicifolia tantum.* – *Parinari sect. Sarcostegia* BENTH. in Hook., Niger Fl. (1849) 335, *excl. P. jackiana (Petrocarya excelsa).* – *Parinari subg. Sarcostegia* (BENTH.) MIQ. Fl. Ind. Bat. 1, 1 (1855) 355, *excl. P. jackiana*;

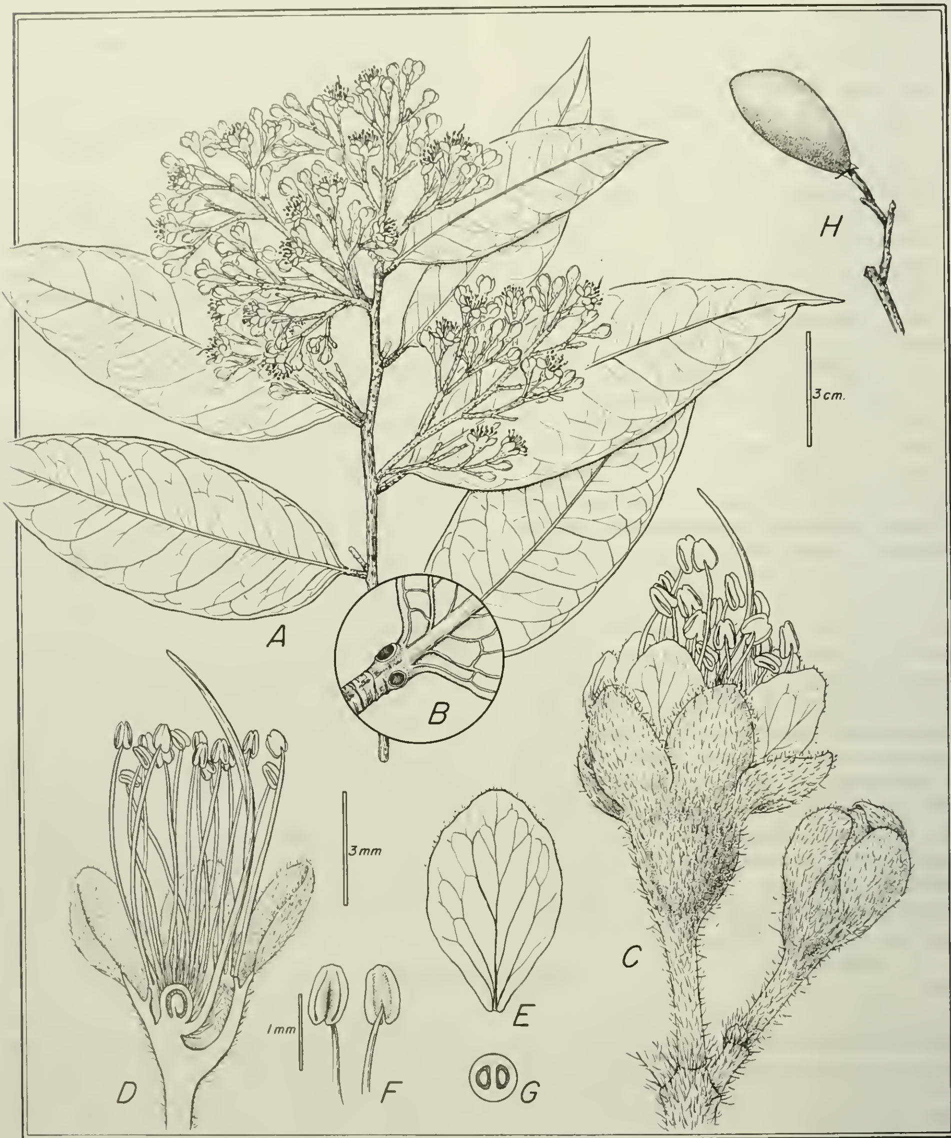

Fig. 21. *Maranthes corymbosa* BLUME. *A*. Habit; *B*. leaf base and glands; *C*. flower and bud; *D*. flower section; *E*. petal; *F*. anthers; *G*. ovary section; *H*. fruit (*A–G* SULIT 19, *H* SINCLAIR 10687).

HAUMAN, Bull. Jard. Bot. Brux. 21 (1951) 185. – *Parinari subg. Exitelia* BLUME, Mélang. Bot. 2 (1855) 10; HASSK. Flora 16 (1858) 255. – *Parinari sect. Exitelia* (BLUME) C.MUELL. in Walp., Ann. 4 (1857) 645. – **Fig. 21.**

Medium-sized to large trees. *Stipules* deltate, intrapetiolar, stiff, caducous. *Leaves* glabrous on both surfaces when mature (or lanate in African species), with dense caducous cobweb-like indumentum when young, without stomatal crypts; with paired glands at junction of lamina and petiole. Petioles eglandular. *Inflorescence* a many-flowered corymbose panicle. Bracts and bracteoles eglandular, caducous, not enclosing flower buds in small groups. *Flowers* hermaphrodite. *Receptacle* obconical, narrowed into pedicel, solid, almost completely filled with nectariferous tissue, short tomentose to glabrous on exterior, glabrous within, calyx lobes suborbicular, deeply concave, unequal. Petals 5, not clawed. *Stamens* 25–40, inserted on margin of disk, unilateral with tooth-like staminodes opposite to almost in a complete circle; filaments far exserted beyond calyx lobes, in a tangled mass. *Ovary* inserted laterally at mouth of receptacle; carpel bilocular with 1 ovule in each loculus. *Style* pubescent at base only, curved upwards, exserted. *Fruit* a large fleshy drupe; epicarp smooth, glabrous, not lenticellate; mesocarp fleshy; endocarp very hard, fibrous with a rough exterior, densely tomentose within, with 2 lateral plates which break away on germination. Germination phanerocotylar. *Cotyledons* fleshy, pale green; cataphylls absent; first 2 eophylls opposite, the others alternate or opposite.

Distr. In tropical Africa 10 species, one native to Central America and one widespread species in *Malesia*, NE. Australia and W. Pacific.

1. **Maranthes corymbosa** BLUME, Bijdr. (1825) 89; KOSTERM. Candollea 20 (1965) 107; PRANCE & WHITM. Tree Fl. Malaya 2 (1973) 330, *excl. syn. Couepia panamensis*. – *Exitelia corymbosa (*BLUME) BLUME, Fl. Java 1, Praef. (1828) vii. – *Maranthes multiflora* KORTH. Verh. Nat. Ges. Ned. Overz. Bezitt., Bot. (1839/42) 259; Ned. Kruidk. Arch. 3 (1855) 281; TEIJSM. & BINN. Cat. Hort. Bog. (1866) 253. – *Exitelia multiflora* (KORTH.) WALP. Rep. 5 (1845/46) 115; MIERS, J. Linn. Soc. Bot. 17 (1879) 336, *sub Exiteles*. – *Parinarium griffithianum* BENTH. in Hook., Niger Fl. (1849) 334; Fl. Austr. 2 (1864) 426; WALP. Ann. 2 (1851/52) 463; BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 98; Mélang. Bot. 2 (1855) 10; MIQ. Fl. Ind. Bat. 1, 1 (1855) 356; *ibid.* (1858) 1084; HOOK. *f.* Fl. Brit. India 2 (1878) 310; MIERS, J. Linn. Soc. Bot. 17 (1879) 336; VIDAL, Sinopsis Atlas (1883) 25; MAINGAY, Kew Bull. (1890) 122; KING, J. As. Soc. Beng. 66 (1897) 283; BAILEY, Queensl. Fl. 2 (1900) 524; K. & V. Bijdr. 5 (1900) 334; K.SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 341; PERK. Fragm. Fl. Philip. (1904) 118; BRANDIS, Indian Trees (1906) 278; FOXW. Philip. J. Sc. 2 (1907) Bot. 386; BACKER, Schoolfl. Java (1911) 446; RIDLEY, Fl. Mal. Pen. 1 (1922) 670; Disp. (1930) 400; CRAIB, Fl. Siam. Enum. 1 (1931) 563. – *Grymania salicifolia* PRESL, Epim. Bot. (1849) 193; WALP. Ann. 3 (1853) 854. – *Parinarium griffithianum* BENTH. in Hook., Niger Fl. (1849) 334; Fl. Austr. 2 (1864) 426; WALP. Ann. 2 (1851/52) 463; BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 98; Mélang. Bot. 2 (1855) 10; MIQ. Fl. Ind. Bat. 1, 1 (1855) 356; *ibid.* (1858) 1084; HOOK. *f.* Fl. Brit. India 2 (1878) 310; MIERS, J. Linn. Soc. Bot. 17 (1879) 336; VIDAL, Sinopsis Atlas (1883) 25; MAINGAY, Kew Bull. (1890) 122; KING, J. As. Soc. Beng. 66 (1897) 283; BAILEY, Queensl. Fl. 2 (1900) 524; K. & V. Bijdr. 5 (1900) 334; K.SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 341; PERK. Fragm. Fl. Philip. (1904) 118; BRANDIS, Indian Trees (1906) 278; FOXW. Philip. J. Sc. 2 (1907) Bot. 386; BACKER, Schoolfl. Java (1911) 446; RIDLEY, Fl. Mal. Pen. 1 (1922) 670; Disp. (1930) 400; CRAIB, Fl. Siam. Enum. 1 (1931) 563. – *Parinarium maranthes* BLUME, Mus. Bot. Lugd.-Bat. 2 (1852) 99; Mélang. Bot. 2 (1855) 10. – *Parinarium corymbosum* (BLUME) MIQ. Fl. Ind. Bat. 1, 1 (1855) 356; *ibid.* (1858) 1084; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 237; WALP. Ann. 4 (1857) 645; VIDAL, Cat. Pl. Len. Silv. Cult. Manila (1880) 29; MERR. Philip. J. Sc. 10 (1915) Bot. 309; Spec. Blanc. (1918) 162;

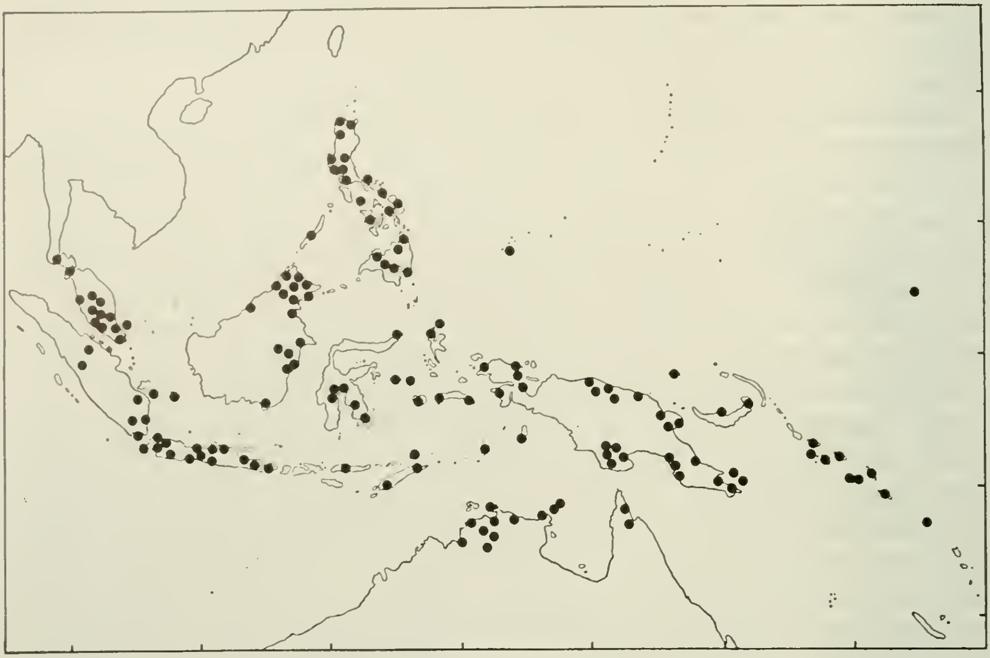

Fig. 22. Distribution of *Maranthes corymbosa* BLUME.

Enum. Born. (1921) 290; Enum. Philip. Fl. Pl. 2 (1923) 235; CRAIB, Fl. Siam. Enum. 1 (1931) 563; BURK. Dict. (1935) 1695; CORNER, Wayside Trees (1940) 527; BACKER & BAKH.*f.* Fl. Java 1 (1964) 522. – *Parinarium multiflorum* (KORTH.) MIQ. Fl. Ind. Bat. 1, 1 (1855) 356; *ibid.* (1858) 1084; Suppl. Sumatra (1860) 115; *ibid.* (1861) 307; C.MUELL. in Walp., Ann. 4 (1857) 646. – *Parinarium salicifolium* (PRESL) MIQ. Fl. Ind. Bat. 1, 1 (1855) 357; C.MUELL. in Walp., Ann. 4 (1857) 646. – *Maranthes speciosa* KORTH. *ex* MIQ. Fl. Ind. Bat. 1, 1 (1855) 357. – *Chrysobalanus ciliatus* KORTH. *ex* MIQ. *l.c.* 357. – *Petrocarya griffithiana* (BENTH.) MIERS, J. Linn. Soc. Bot. 17 (1879) 336. – *Parinarium racemosum* VIDAL, Cat. Pl. Len. Silv. Cult. Manila (1880) 29. – *Ferolia griffithiana* (BENTH.) O. KTZE, Rev. Gen. Pl. 1 (1891) 216. – *Ferolia corymbosa* (BLUME) O. KTZE, *l.c.* 216. – *Ferolia salicifolia* (PRESL) O. KTZE, *l.c.* 216. – *Parinarium nitidum auct. non* BENTH.: KOORD. Meded. Lands Planten Tuin Btzg 19 (1898) 448. – *Polyalthia pulchrinervia* BOERL. Cat. Pl. Hort. Bog. (1899) 20; Icon. Bog. 1 (1899) 106. – *Parinarium palauense* KANEHIRA, Bot. Mag. Tokyo 45 (1931) 282; Fl. Micrones. (1933) 129; J. Dept. Agr. Kyushu Imp. Univ. Fukuoka 4 (1934) 325. – **Fig. 21.**

Small to large tree up to 40 m, sometimes flowering when only a few metres high, trunk not buttressed or slightly enlarged at base. *Stipules* intrapetiolar, lanceolate, acute, 5–10 mm long, sparsely pilose on exterior, glabrous within, early deciduous. *Leaves* coriaceous, usually oblong-lanceolate to oblong-elliptic, 6.5–14 by 2.5–8 cm, acuminate at apex, the acumen 8–20(–30) mm long, cuneate at base, glabrous when mature but often sparsely caducous arachnoid-lanate when young, usually with 2 conspicuous prominent glands at junction of petiole and decurrent lower surface; primary veins 7–10 pairs, arcuate, prominulous on both surfaces; midrib plane above, prominulous beneath; petioles 4–9 mm long, glabrous when mature, flattened above. *Inflorescences* of flattened many-flowered corymbose panicles, rachis and branches sparsely pilose, glabrescent. Bracts and bracteoles ovate to lanceolate, sparsely pubescent, caducous. *Receptacle* turbinate, tapering into pedicels 2–4 mm long, grey tomentose to glabrous on exterior, glabrous within, calyx lobes fleshy, ovate to elliptic, obtuse, 2.5–4 mm long, unequal. Petals white tinged pink, glabrous, 3–6 mm long, caducous. *Stamens* 25–35 inserted in several rows on one side of throat, with tooth-like staminodes opposite. *Ovary* bilocular, densely lanate and villous. *Style* glabrous except at base; stigma truncate. *Fruit* ellipsoid, 3–4 mm long, 1.5–2 cm broad, tapered towards base; epicarp thin, glabrous on exterior when mature, sometimes lanate when young; endocarp hard, 5 mm thick, rough on exterior; densely lanate within; bilocular usually with seed in one locule only. Cotyledons plane-convex.

Distr. S. Thailand extending east to Solomon and Caroline Islands and Australia (Queensland, Northern Territory); in *Malesia*: Malay Peninsula, Sumatra, Java, Borneo, Lesser Sunda Islands, Sulawesi, Philippines, Moluccas, New Guinea, New Britain and Admiralty Islands. Fig. 22.

Ecol. Common in coastal areas on rocky and sandy hills and extremely inland up to 600 m altitude. Also in gallery forest and in Australia on sand dunes behind mangrove swamp. In Kalimantan the fruit is eaten by many bird species, including hornbills and fruit pigeons, which probably disperse the seed. The seed is also scatter-hoarded by the squirrel *Sundasciurus hippurus*. African species of *Maranthes* are bat-pollinated.

Uses. Wood used for house-building and for posts. Fruit edible.

Vern. Thailand: *chi-kat-pen, chi-ot-pen*, Korat; Malay Peninsula: *chana, lejin, merbatu, m. layang, mujagon, sau hutan, sunko rimau*; Sumatra: *damor lilis, kajie batu, kaju batu*, Banka, *kalek kureseng, k. parada*; Java: *gesing, kituwat, solo, sulo, triwulan, wuloh*, Jav., *taritik, t. monjet*, Sund.; Borneo: *bangkawang, bonsissian*, Malay; *bansisian*, Sabah, Tengara; *nyalin laat*, Sarawak; *buenza, kajebabu, kajoe kambang, kambang, potang*, Kalimantan; Sulawesi: *kolaka*; Tidore: *latan*, Aru Is.; Philippines: *almag, delebaybai, kaphangan, kolaka, kolasa, kulingan, malapiga, malapuyan, sampinit, takdangan*, Tag., *aningat, binggas, caratacat, kagemkena, karatakat*, Ilk., *arangan*, Tagb., *dakayau*, Pang., *bakoyan, tapas*, P.Bis., *bongog, dau, mata-mata, sarangun*, S.-L.Bis., *dumaga*, Kuy., *kagangan, kalakangon, ogat*, Bag., *kamuli tingan*, Pamp., *lank angan*, Lan., *langog*, Buk., *lumaluas, sigaadan*, Mag., *maluktik*, Sul., *salipungan, salutui*, Neg., *bareraga, barit*, Bik., C.Bis., *laiusin*, Bik., S.C.Bis., *liusin*, Sbl., Tag., Bik., *sabongkaag*, Ilk., Ting., *tadiang manok*, Ting., Tag.; New Guinea: *badigal*, Wagu, *djuramun*, Kemtuk, *jambuan*, Kaigorin, *kaupen*, Jal, *kawol, kowot*, Muyu, *kwanu*, Maprik, *lakan, luikoko*, Bush Mekeo, *marigag*, Sinai, *mehlue*, Bembi, *morolee, mun*, Dagu, *naas, ningua, njali*, Nemo, *njiwa, niwa*, Sidei, *paguh*, Timbunke, *phu*, Wasuk, *watu*, Karopa; Solomon Is.: *asikisiki, giza, mon warlu, morigag, now-wa-ru, santalan*; Bougainville: *mon-warku*, Kugumaru, *marigai*, Siwai, Bouin; Palau Is.: *apgau*.

8. KOSTERMANTHUS

PRANCE [Tree Fl. Malaya 2 (1973) 327, unpublished], Brittonia 31 (1979) 91; PRANCE & WHITE, Phil. Trans. Roy. Soc. Lond. 320 (1988) 149, f. 40, 41. – *Parinari auct. non* AUBL.: *quoad P. heteropetala* SCORTECH. *ex* KING *et P. myriandra* MERR., *tantum*. – *Acioa auct. non* AUBL.: KOSTERM. Reinwardtia 7 (1965) 9. – **Fig. 23.**

Large trees, ultimate shoots not divaricate. *Stipules* to 7 mm long, foliaceous, persistent, lanceolate to ovate. *Leaves* glabrous on both surfaces with minute papillae on veins giving a beaded appearance. Petioles eglandular. *Inflorescence* an unbranched or little-branched terminal or axillary raceme with shortly stalked congested cymules proximally and singly inserted flowers distally. Bracts and bracteoles small, suborbicular, persistent, eglandular, not enclosing groups of flower buds. *Flowers* hermaphrodite, strongly zygomorphic. *Receptacle* broadly obconic-campanulate, shorter than calyx lobes, asymmetric, hollow, hairy on both surfaces, but throat not blocked by retrorse hairs; calyx lobes 5, markedly unequal, suborbicular to lingulate, strongly imbricate. Petals 5, unequal in size and shape, the 2 posterior larger than the others, markedly ungulate and enclosing stamens in bud. *Stamens* 8–30, inserted unilaterally on margin of disk; filaments united for half to three quarters of length into a strap; staminodes 5–8, inserted opposite stamens. *Ovary* inserted laterally at mouth of receptacle; unilocular with 2 ovules. *Fruit* large, hard; epicarp glabrous,

Fig. 23. *Kostermanthus heteropetalus* (SCORTECH. *ex* KING) PRANCE. *A*. Habit; *B*. flower section; *C* & *D* petals; *E*. stamen; *F*. fruit; *G*. ovary section (*A–E, G* OGATA KEP 105153, *F* MEIJER SAN 34279).

crustaceous-verrucose; endocarp hard, thick, glabrous within, breaking irregularly on germination. *Cotyledons* slightly ruminate.

Distr. *Malesia*: Malay Peninsula, Sumatra, Borneo, Sulawesi, Philippines (Mindanao); 2 species.

KEY TO THE SPECIES

1. Leaves coriaceous; petioles 6–12 mm long; calyx tube 2–3 mm long, broadly campanulate .... **1. K. heteropetalus**
1. Leaves chartaceous; petioles 2–3 mm long; calyx tube 5 mm long, slender .... **2. K. malayanus**

1. Kostermanthus heteropetalus (SCORTECH. *ex* KING) PRANCE, Brittonia 31 (1979) 91; PRANCE & WHITE, Phil. Trans. Roy. Soc. Lond. 320 (1988) 152 – *Parinarium heteropetalum* SCORTECH. *ex* KING, J. As. Soc. Beng. 66 (1897) 283; RIDLEY, Fl. Mal. Pen. 1 (1922) 670; NAYARANASWAMI, J. As. Soc. Beng. n.s. 27 (1931) 368. – *Parinarium kunstleri* KING, J. As. Soc. Beng. 66 (1897) 282; RIDLEY, Fl. Mal. Pen. 1 (1922) 670. – *Parinarium myriandrum* MERR. Univ. Cal. Publ. Bot. 15 (1929) 93. – *Acioa heteropetala* (SCORTECH. *ex* KING) KOSTERM. Reinwardtia 7 (1965) 11. – **Fig. 23.**

Tree to 35 m tall, older trees buttressed to 1 m up trunk; young branches glabrous, lenticellate. *Stipules* 6–7 mm long, partly intrapetiolar, carinate, ovate, foliaceous, acute to acuminate, persistent to subpersistent. *Leaves* coriaceous, usually elliptic-subovate to rarely lanceolate, 5–20 by 2.5–6 cm, bluntly acuminate at apex, cuneate to rounded at base, glabrous on both surfaces, minutely papillose on venation of both surfaces giving a bead-like appearance; midrib prominulous above, prominent beneath; primary veins 6–10 pairs, arcuate, slender, prominent beneath; petioles 6–12 mm long, sometimes lightly alate from decurrent leaf margins, slightly flattened above, eglandular. *Inflorescences* little-branched, to 10 cm long, the rachis and branches lightly tomentellous; bracts and bracteoles ovate, acute, to 3 mm long, caducous. *Receptacle* broadly campanulate, 2–3 mm long, tomentose on both surfaces; calyx lobes fleshy, unequal, acute, to 7 mm long, pilose on both surfaces, reflexed in open flowers. Petals white tinged pink, fleshy, ellliptic, concave, largest up to 15 mm long, tomentellous on exterior, enveloping staminal ligule, the others much smaller to 6 mm long. *Stamens* 25–30 united into a unilateral ligule for 2/3 length, to 12 mm long, glabrous; anthers pubescent. *Ovary* densely pilose. *Style* densely appressed pilose, stigma truncate. *Fruit* ovoid, unilocular 4 by 3 cm; epicarp glabrous, crustaceous; endocarp hard, thick. Cotyledons slightly ruminate, 1.5 by 3 cm.

Distr. *Malesia:* Malay Peninsula, Sumatra, Borneo, Sulawesi, Philippines (Mindanao). Fig. 24.

Ecol. From sea level up to 500 m altitude.

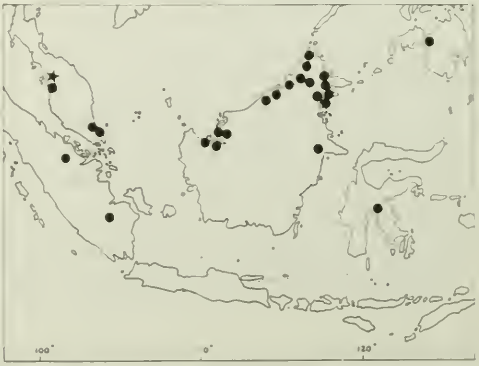

Fig. 24. Distribution of *Kostermanthus heteropetalus* (SCORTECH. *ex* KING) PRANCE (dots) and *K. malayanus* (KOSTERM.) PRANCE (star).

2. Kostermanthus malayanus (KOSTERM.) PRANCE, Brittonia 31 (1979) 94; PRANCE & WHITE, Phil. Trans. Roy. Soc. Lond. 320 (1988) 152. – *Acioa malayana* KOSTERM. Reinwardtia 7 (1965) 13.

Small tree to 10 m; young branches glabrous, lenticellate. *Stipules* lanceolate, acute, glabrous, subpersistent, *c.* 5 mm long. *Leaves* chartaceous, elliptic, 14–20 by 6.5–8.5 cm, acuminate at apex, the acumen 4–10 mm long, cuneate at base, glabrous on both surfaces; midrib slightly prominulous to plane above, prominent beneath, with a pair of round glands at base; primary veins 10–13 pairs, prominulous above, prominent beneath; petioles 2–3 mm long, glabrous, slightly alate with decurrent leaf margins. *Inflorescence* of subterminal racemes or little branched, the rachis brown pilose pubescent; bracts and bracteoles ovate, acute, to 3 mm long, caducous. *Receptacle* slender cylindrical, 5 mm long, sessile tomentose on exterior, densely tomentose within; calyx lobes ovate, acute, 4–5 mm long, densely tomentose on exterior, glabrous within except at apex. Petals spathulate, 6 mm long, clawed. *Stamens* 8–10, united into a unilateral ligule for half of length. *Ovary* densely pilose. *Style* pilose for most of length. *Fruit* unknown.

Distr. *Malesia*: Malay Peninsula (Penang). Known only from the type collection.

Insufficiently known

Acioa percoriacea KOSTERM. Reinwardtia 7 (1965) 14.

This species was described from a single sterile collection from the Malay Peninsula, and distinguished from *Kostermanthus heteropetalus* PRANCE by its pubescent branches and caducous pubescent leaf undersurfaces. It is impossible to evaluate until further material is collected, but almost certainly belongs within *K. heteropetalus*.

SABIACEAE (C.F. van Beusekom & Th.P.M. van de Water, Leiden)[1]

Trees, scandent shrubs or woody climbers. *Leaves* alternate or spirally arranged, penninerved, simple or imparipinnate, the leaflets in the latter case opposite on often somewhat swollen nodes of the rachis; exstipulate. *Flowers* small, bisexual, rarely polygamo-dioecious, in terminal or axillary racemose panicles, or cymose: paniculately arranged cymes, or these reduced to solitary axillary flowers. *Sepals* (3–)5, imbricate, free or ± connate at the base, equal or unequal. *Petals* (4–)5, mostly opposite the sepals (rarely alternate: *Ophiocaryon spp.*, South America). *Stamens* (including staminodes) 5, opposite the petals, all polliniferous (*Sabia*) or only 2 inner ones opposite the reduced petals polliniferous and the other 3 staminodial. *Disk* small, annular, surrounding the base of the ovary. *Ovary* of 2(–3) carpels united to form a compound superior ovary, carpels very rarely free in the apical part, in that case tapering to 3 short styles with a capitate stigma; otherwise normally a short, cylindric or conical style; cells 2(–3), each with 1 or 2 pendulous or horizontal, axile hemitropous, unitegmic, crassinucellar ovules. *Fruit* either 1-celled or 2-coccous, drupaceous or dry, indehiscent; endocarp often wrinkled. *Endosperm* scanty or wanting. *Embryo* with a curved radicle and 2 folded or coiled cotyledons.

Distribution. Three genera: *Sabia* Indo-Malesian, from the S. Deccan and Kashmir to S. Japan, throughout Malesia as far as the Solomons; *Meliosma* with a similar range but also occurring in tropical America; *Ophiocaryon* in the Neotropics. The family is absent in Australia and Africa.

Fossils of both Malesian genera are found onwards of the Oligocene and Eocene in Asia and Europe. See under the genera.

Ecology. Tropical forests, mostly below 2000 m altitude.

Taxonomy & Delimitation. There is no concensus of opinion on the affinity, hence the systematic position of *Sabiaceae*. Some even doubt whether *Sabia* and *Meliosma* are correctly placed in one family.

After the description of *Sabia* by COLEBROOKE (1818), BLUME (1851) accommodated it in a new monogeneric family, *Sabiaceae*, suggesting its affinity with *Menispermaceae*. Shortly afterwards MIERS (see LINDLEY, 1853), while working on *Menispermaceae*, placed *Sabia* between that family and *Lardizabalaceae*. HOOKER *f.* & THOMSON (1855) considered the genus intermediate between *Menispermaceae* and *Schisandraceae*.

The scandent habit and the resemblance of the drupelets of *Sabia* with those of *Menispermaceae* undoubtedly were a major argument for supposed affinity.

Subsequently BENTHAM & HOOKER (1862) extended the then monogeneric family *Sabiaceae* to include *Meliosmaceae* ENDL., adding the genera *Meliosma* BLUME and *Ophiocaryon* SCHOMB.; both are trees, the first Asian-American, the latter tropical American. They removed the family in its new concept from the Menispermaceous affinity and accommodated *Sabiaceae* near *Sapindaceae* and *Anacardiaceae*. This position has been stable for a century and was adhered to by many leading botanists: WARBURG (1895), VON WETTSTEIN (1911), HUTCHINSON (1926, 1973), MELCHIOR (1964), TAKHTAJAN (1969), DAHLGREN (1975, 1983), and THORNE (1976, 1983). Some of these authors showed some doubt about the position and some made suggestions, *e.g.* WARBURG (*l.c.* 370), who believed one could possibly derive the flower of *Meliosma* from the Meni-

(1) Accommodated from the monographs of both authors in Blumea volumes 19 and 26, and provided with an introduction.

spermaceous scheme and mentioned that RADLKOFER was not in favour of an affinity with *Sapindaceae* or *Anacardiaceae*.

In recent years there is a tendency to return to BLUME's opinion towards affinity with *Menispermaceae*. Pollen morphology (ERDTMAN, 1952) and embryology (MAURITZON, 1936) have been interpreted in favour of a relationship with *Menispermaceae*. AIRY SHAW (1973) remarked that the opposition of calyx, corolla and stamens is a most unusual feature, but can probably be derived from the Menispermaceous type of flower. In his recent classification CRONQUIST (1981) tentatively placed *Sabiaceae* near *Menispermaceae* in the *Ranunculales*. Also FORMAN, in his treatment of the *Menispermaceae* (Fl. Males. I, 10^2, 1986, 157–253), shares this opinion.

Another matter is whether *Sabia* and *Meliosma/Ophiocaryon* should be accommodated in one family; hitherto they are represented by two tribes in *Sabiaceae* (WARBURG, 1890), differing in habit (climbers versus trees), the leaves, and in the androecium. Moreover, CRONQUIST (1981) mentioned in his discussion that, according to WOLFE, the leaf venation of *Sabia* is highly compatible with a position near *Menispermaceae*, but that of *Meliosma* more similar with some members of the *Rosidae*. There may be more arguments to accommodate *Meliosma* in a separate family *Meliosmaceae* ENDL., apart from *Sabiaceae sensu stricto*. This opinion was held by AIRY SHAW (1973).

References: AIRY SHAW in Willis, Dict. ed. 8 (1973) 1017; BENTHAM & HOOKER, Genera Plantarum 1 (1862) 413; BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 369; CRONQUIST, An integrated system of classification of flowering plants (1981) 140; DAHLGREN, Bot. Notis. 128 (1975) 126; Nordic J. Bot. 3 (1983) 144; ERDTMAN, Pollen morphology and plant taxonomy (1952) 380; HOOKER *f.* & THOMSON, Flora Indica 1 (1855) 208; HUTCHINSON, Families of flowering plants 1 (1926) 254; ed. 3 (1973) 449; LINDLEY, Vegetable kingdom ed. 3 (1853) 467; MAURITZON, Acta Hort. Goth. 11 (1936) 18; MELCHIOR, Engler's Syllabus 2 (1964) 285; TAKHTAJAN, Flowering plants: origin and dispersal (1969) 226; THORNE, Evol. Biol. 9 (1976) 61; Nordic J. Bot. 3 (1983) 106; WARB. in E. & P., Nat. Pfl. Fam. 3, 5 (1895) 367; WETTSTEIN, Handb. Syst. Bot. ed. 2 (1911) 633.

Vegetative Anatomy. – *Leaf anatomy*. Hairs unicellular in *Sabia*; uniseriate nonglandular and capitate glandular in *Meliosma*. Stomata confined to the lower leaf surface, anomocytic or paracytic. Mesophyll dorsiventral, with arm palisade cells in *Meliosma*. Veins embedded in mesophyll and sheathed by sclerenchyma. Petiole in distal end with a closed vascular cylinder. Crystalliferous cells containing clusters common near the veins.

Young stems. Cork superficial. Cortex with stone cells in some species of *Meliosma*. Pericyclic sclerenchyma forming a composite, closed ring in *Sabia*, and composed of isolated fibre groups in *Meliosma*. Phloem with broad lignified rays in *Sabia*, and with non-lignified, dilatating (triangular) rays in *Meliosma*. Vessels with mixed simple and scalariform perforations in first formed xylem. Cluster crystals common in cortex, phloem, and pith. Secretory cells with unidentified contents noted in parenchyma of several *Meliosma* species.

Wood anatomy. Vessels exclusively solitary in *Sabia*, solitary and in radial multiples or small clusters in *Meliosma*; vessel perforations typically simple in *Sabia*; mixed simple and scalariform or exclusively scalariform to reticulate in *Meliosma*. Intervessel pits alternate. Vessel–ray and vessel–parenchyma pits simple, and often large. Fibres, usually thin-walled, with minutely bordered to simple pits, and mainly confined to the radial walls in *Meliosma* (libriform fibres); with distinctly bordered pits common in both the radial and tangential walls in *Sabia*; occasionally septate. Parenchyma scanty paratracheal to vasicentric with occasional lateral extensions in *Meliosma*, very sparse to almost absent in *Sabia*, usually in 8-celled strands. Rays sometimes of two different sizes, the broad ones 4–8(–15) cells wide in *Meliosma*, up to 20 cells wide in *Sabia*, usually over 2 mm high, heterogeneous (Kribs type II), often with sheath cells.

Taxonomic note based on vegetative anatomy. The above description is mainly based on early studies of a very limited number of species, so that the information is far too limited to serve in the discussion of infrageneric classification and delimitation. The two genera are anatomically quite distinct in their leaf and wood anatomy. Partly this is related to general anatomical differences between climbers (*Sabia*) and erect shrubs or trees (*Meliosma*). Thus, the anatomical evidence can be interpreted both in favour of the separation of *Meliosma* and *Sabia* into two families, or alternatively to retain their tribal position in the same family. Anatomically *Sabia* is quite distinct from the *Menispermaceae* to which it has been compared (see above, under taxonomy); affinity of *Meliosma* and *Sabia* with families of the *Sapindales*, especially *Anacardiaceae* seem to find more support in vegetative anatomy.

References: CARLQUIST, Aliso 11 (1985) 139–157; DESCH, Manual of Malayan Timbers 2 (1954) 522–523; METCALFE & CHALK, Anatomy of the Dicotyledons 1 (1950) 448–452; MOLL & JANSSONIUS, Mikrographie des Holzes 2 (1922) 424–437; SOLEREDER, Systematische Anatomie der Dicotyledonen (1899) 276–278; & Ergänzungsband (1908) 108–109. – P. BAAS.

Palynology. Pollen grains in *Sabiaceae* are prolate spheroidal to prolate. Size ranges from 20 to 33 µm. The apertural system is always tricolporate. Ectoapertures are long colpi, endoapertures are lalongate pori or short colpi. The shape of the endoapertures is oblong to elliptic, sometimes approximately rectangular or meridionally constricted. Exine stratification is easily to observe in the light microscope. Each layer is about uniformly thick throughout. The tectum is equally thick or up to twice as thick as the nexine. It is mostly more than twice as thick as the columellate layer. Total exine thickness is 1–2.5 µm. The ornamentation is usually finely to coarsely reticulate; sometimes it is finely or indistinctly perforate.

Meliosma and *Sabia* show only little infrageneric variation. Moreover, the ranges in both genera are rather similar. Only minor differences exist: *Sabia* mostly has a thinner exine with a finer reticulate ornamentation than *Meliosma*. Pollen morphology does not support accommodating the genera in separate families (MONDAL & MITRA, 1982).

As taxonomists, pollen morphologists are ambiguous with respect to the position of the *Sabiaceae*. ERDTMAN (1952) reported pollen similar to that of *Sabiaceae* to occur in several other families. However, he actually mentioned only the *Menispermaceae*. Pollen of *Anacardiaceae* and *Sapindaceae* was considered less similar or different. According to MONDAL & MITRA (*l.c.*) *Sabiaceae* pollen differs from that of *Aceraceae, Hippocastanaceae, Lardizabalaceae, Melianthaceae, Menispermaceae, Sapindaceae*, and *Schizandraceae*. On the basis of grain shape and size, P/E ratio, exine structure and aperture characters they suggested to classify the *Sabiaceae* nearest to the *Anacardiaceae*. It must be stressed, however, that it is extremely difficult to infer relationships from resemblances between rather simple pollen types. Obviously unrelated taxa may show very similar pollen, whereas closely related taxa sometimes have completely different pollen.

References: ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 390; MONDAL & MITRA, Geophytology 12 (1982) 166–180. – R.W.J.M. VAN DER HAM.

Phytochemistry. The only observations worth to be reported here are the presence of pentacyclic triterpenoids of the oleanene series and the absence of starch in seeds. The 3-acetates of oleanolic acid and oleanolic aldehyde were isolated from bark of *Meliosma simplicifolia*. Seeds of *Meliosma myriantha* SIEB. & ZUCC. (continental SE. Asia) were reported to give positive reactions for alkaloids and to contain 8% of protein and 10% of fatty oil but no starch.

References: DESAI *c.s.*, Indian J. Chem. 15B (1977) 291; HEGNAUER, Chemotaxonomie der Pflanzen 6 (1973) 240. – R. HEGNAUER.

Note. Though the genera are extremely clearly defined, specific delimitation has in both genera been difficult, as it seems that racial segregation is common in both. VAN DE WATER has in *Sabia* employed a finer specific distinction than VAN BEUSEKOM did in *Meliosma*.

KEY TO THE GENERA

1. Climbers or scandent shrubs. Flowers with 5 equal, fertile stamens, in usually rather few-flowered thyrses or cymes, sometimes reduced to a single axillary flower. *Leaves* simple, entire or subentire, alternate **1. Sabia**

1. Trees. Flowers in usually large, racemose, terminal or axillary panicles. Fertile stamens only 2, the other 3 abortive and reduced to scales or nectary-like bodies. Leaves uneven pinnate, leaflets opposite on ± noded rachis, rarely simple, entire or toothed, spirally arranged .... **2. Meliosma**

1. SABIA

COLEBROOKE, Trans. Linn. Soc. Lond. 12 (1818) 355, t. 14; WALL. in Roxb., Fl. Ind. 2 (1824) 308; BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 368; WARB. in E. & P., Nat. Pfl. Fam. 3, 5 (1895) 367, f. 183A, 184A–H; CHEN, Sargentia 3 (1943) 1; VAN DE WATER, Blumea 26 (1980) 1. – *Meniscosta* BLUME, Bijdr. (1825) 28; DIETR. Syn. Pl. 2 (1840) 923 (*'Menicosta'*). – **Fig. 2–4.**

Evergreen or deciduous, woody climbers or more or less scandent shrubs (rarely recorded as small trees). *Twigs* terete, striate (see note), with ± prominent leaf cushions, unarmed, mainly in deciduous species with some cataphylls at their base, spirally arranged. *Buds* either ± globular and obtuse to rounded, or ovoid and acute; scales glabrous to pubescent, ciliolate or not, persistent at the base of the twigs. *Leaves* simple, ovate or elliptic to lanceolate, 2–25 by 1–10 cm, herbaceous to coriaceous, petioled, entire or very rarely subentire; nerves 3–12 pairs, ascending to patent, curved to straight. *Flowers* bisexual, 5-merous, actinomorphic, up to *c.* 15 mm diam., green to white, yellow, or purple, axillary, either solitary, or arranged in a few- to many-flowered cyme, appearing before or with the new leaves. *Cymes* axillary, either solitary, or, when the subtending leaves are shed or are bract-like, arranged in racemose to thyrsoid or sometimes corymbose inflorescence, pedicel ± thickened upwards in fruit; bracts ovate to lanceolate, up to 6 mm, bracteoles as bracts but usually smaller, or sepal-like, or minute and then often situated near calyx. *Sepals* 5(–7, see bracteoles), equal to very unequal mutually, mostly ± confluent at the base, variable in size and shape but often suborbicular or broad-ovate to ovate, persistent. *Petals* 5, rarely 6 or 7, episepalous, imbricate, suborbicular to lanceolate, glabrous, sometimes (sub)ciliolate, persistent or not; nerves ± parallel, branching or not, sometimes conspicuous when dark-coloured. *Stamens* 5, epipetalous, ± equal, persistent or not; filaments more or less flattened, adherent to the base of the subtending petals; anthers globular to ellipsoid, introrse, upright or inflexed. *Disk* in most species ± crown-shaped, sometimes short-cylindrical (*S. sumatrana*), truncated conical, or ± cushion-shaped; lobes and ribs, if present, alternating with the stamens. *Pistil*: style conical to cylindrical, rarely absent, persistent. *Ovary* superior, 2-celled, (sub)globose to subreniform, usually laterally somewhat compressed, very rarely subapocarpous. *Ovules* 2 per cell, more or less superimposed, attached to the septum, hemi-anatropous. *'Drupelets'* 1-seeded or very rarely with 2 seeds, (sub)globose, obovoid, oblong-obovoid (or pyriform), or subreniform, laterally ± compressed, green or white to red or deep blue when fresh; mesocarp rather thin, pulpy, sometimes with many dark 'granules', endocarp crustaceous, very often with ± prominent ribs

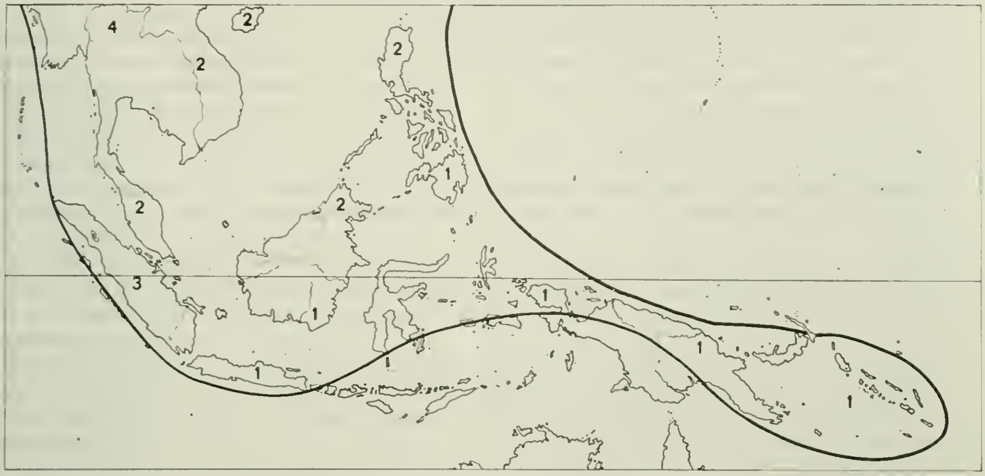

Fig. 1. The Southeast Asian and Malesian distribution area of *Sabia* COLEBROOKE. The numbers refer to the number of species in that area.

forming a fine to coarse reticulate pattern, margin sometimes distinctly keeled. *Seed* conform to the drupelet; testa usually conspicuously dark-dotted, inside often lined with a very thin layer of endosperm. *Embryo* with two flat, smooth, somewhat undulated, or sometimes strongly folded cotyledons and a cylindrical rootlet curving to the hilum.

Distr. Indo-Malesia, along the Himalayas (1 species disjunct, also in the S. Deccan) through Burma and China to S. Japan; throughout *Malesia* (not yet known from the Lesser Sunda Islands), as far as New Guinea, the Louisiades and Solomon Islands. In all 19 species, of which 7 in Malesia. Fig. 1.

Ecol. Inconspicuous climbers (rarely reported as small trees), except two continental Asian species all evergreen, found in forests and thickets, from the lowland up to *c.* 1000–1200 m altitude, *S. javanica* up to 1500 m and *S. pauciflora* to 2000 m; *S. racemosa ssp. kinabaluensis* is mainly montane, at 800–1500 m. Flowering occurs mostly throughout the year.

KEY TO THE SPECIES

1. Flowers solitary, sometimes 2 or 3 together, or arranged in a thyrsus; ovary glabrous; style in flower 3–6 mm long, conspicuous in fruit and about half as long as the adjacent side(s) of the drupelet(s) **7. S. sumatrana**
1. Flowers in cymes, these solitary, axillary, up to 30(–40)-flowered; ovary densely pubescent; style in flower 2.25–2.5 mm long; drupelets not known .... **1. S. erratica**
1. Flowers in few- to many-flowered cymes; cymes either solitary, axillary, or arranged in an up to 15 cm long racemose to thyrsoid inflorescence, (1–)2–25-flowered; ovary glabrous; style in flower up to 1.5(–1.75) mm long, inconspicuous in fruit and much shorter than the adjacent side(s) of the drupelet(s).
   2. Leaves oblong to lanceolate, 3–12(–15) by 1–5 cm, beneath usually distinctly paler than above; nerves (5–)6–9(–10) pairs, patent, straight; cymes solitary, axillary, (4–)7–25-flowered; style either absent or obscurely or normally developed, (0.75–) 1–1.5(–1.75) mm long .... **4. S. parviflora**
   2. Leaves elliptic-oblong to sublanceolate, 5–25 by 2–10 cm, beneath usually somewhat paler than above but not conspicuously so; nerves 4–8(–9) pairs, ± patent, straight to curved; cymes often arranged in an up to 15 cm long racemose to thyrsoid inflorescence, (1–)2–10(–12)-flowered, sometimes solitary, axillary, up to 4(–6)-flowered; style normal-developed, 0.2–1 mm long.
      3. Cymes up to 2 cm, 1–4(–6)-flowered; petals suborbicular to elliptic, 1.75–2.5 by 1.25–2 mm, obtuse

to rounded; stamens nearly as long as petals; drupelets globular to obovoid, very compressed, 11–14 by 10–13 mm; reticulate pattern usually faint or absent .... **3. S. limoniacea**

3. Cymes up to 1 cm, 1–4(–7)-flowered; petals either oblong-ovate to ovate-lanceolate, acute, acuminate or not, or elliptic-oblong to oblong, obtuse, 3.5–6.5 by (1.25–)1.5–2.5 mm; stamens distinctly shorter than petals; drupelets obovoid, ± compressed, *c.* 10–12 by (7–)8–10 mm; reticulate pattern rather faint but usually visible, often limited to the margin .... **6. S. racemosa**

3. Cymes up to 2(–3.5) cm, (1–)2–10(–12)-flowered; petals oblong, 2.5–4(–4.5) by *c.* 1–1.5 mm, obtuse; stamens distinctly shorter than petals; drupelets obovoid or ± globular, ± compressed, 7.5–11 by 8–10(–11) mm; reticulate pattern usually clearly visible, sometimes obscure, limited to the margin or not.

4. Leaves oblong to sublanceolate, 5–14(–18) by 2–6(–8) cm; nerves (5–)6–8(–9) pairs; cymes either arranged in a racemose to thyrsoid inflorescence, or solitary, axillary, 1–4-flowered; style 0.6–1 mm; drupelets ± globular, sometimes somewhat obovoid, compressed, 7.5–11 by 8–10(–11) mm **5. S. pauciflora**

4. Leaves elliptic-oblong to oblong, sometimes sublanceolate, 6–19 by 2–8(–10) cm; nerves 4–7(–8) pairs; cymes usually arranged in a thyrsoid inflorescence, sometimes subtended by small leaves, 3–10(–12)-flowered; style 0.2–0.5 mm; drupelets obovoid, sometimes globular, somewhat compressed, 9–11 by *c.* 9–10 mm .... **2. S. javanica**

1. Sabia erratica VAN DE WATER, Blumea 26 (1980) 35.

Evergreen, woody. *Twigs* glabrous to somewhat pubescent; flowering twigs up to 2.5 mm diam., ± lax-pubescent. *Buds* ovoid, acute; scales ± pubescent, ciliolate. *Leaves* oblong, 5–8 by 2.5–3 cm, index 2–2.7, pergamentaceous, above glabrous or still sparsely pubescent especially at the base and on midrib, beneath laxly pubescent especially on midrib and nerves; base acute, apex acute or short-acuminate; nerves 6–7 pairs, patent, ± straight to somewhat curved; petiole up to 1.5 cm, glabrous to pubescent. *Cymes* solitary, axillary up to 4.5 cm, up to 40-flowered, ± lax-pubescent; pedicels up to 4 mm; bracteoles oblong to oblong-ovate, up to 0.8 mm, pubescent, ciliolate. *Sepals* ovate to somewhat elliptic, 0.8–1 by 0.5–0.75 mm, obtuse to acute, ± pubescent, ciliolate. *Petals* oblong or oblong-ovate to sublanceolate or ovate-lanceolate, 3.75–4 by 1–1.5 mm, acute to narrow-obtuse, subciliolate, nerves up to 6, dark-coloured. *Stamens* 2.3–3 mm; filament flattened, 1.8–2.6 by 0.25–0.4 mm; anther ellipsoid to oblong-ellipsoid, *c.* 0.4–0.6 mm, upright. *Disk* crown-shaped; lobes very short or absent; ribs ± prominent. *Pistil* 2.75–3 mm; style narrowly-conical to cylindrical, 2.25–2.5 mm, with some hairs at the base; ovary somewhat globular to subreniform, 0.5–0.6 by 0.6–0.8 mm, densely pubescent. *Drupelets* not available.

Distr. *Malesia*: Singapore (Bt. Timah Res.), only known from the type, collected in 1940.

Notes. In habit somewhat resembling *S. parviflora* but readily distinguished by floral characters.

On the label noted as a 'tree, 100 ft', but this is suspected to be a wrong annotation or field observation or a wrong label.

2. Sabia javanica (BLUME) BACKER *ex* CHEN, Sargentia 3 (1943) 59; BACKER & BAKH.*f.* Fl. Java 2 (1965) 144; VAN DE WATER, Blumea 26 (1980) 39. – *Meniscosta javanica* BLUME, Bijdr. (1825) 29. – *Meniscosta scandens* BLUME *ex* SPRENG. Syst. Veg. 4, 2 (1827) 114, *nom. illeg.*; DIETR. Syn. Pl. 2 (1840) 923. – *Sabia meniscosta* BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 369, f. 44, *nom. illeg.*, *incl. var. firma* BLUME, *var. latifolia* BLUME *et var. glabriuscula* BLUME; MIQ. Fl. Ind. Bat. 1, 2 (1859) 618 (*'menicosta'*); Fl. Arch. Ind. (1870) 71; *ibid.* (1871) pl. 31, *incl. var. elliptica* MIQ.; HOOK.*f.* Fl. Brit. India 2 (1876) 3 (*'menescorta'*); BACKER, Schoolfl. Java (1911) 273; KOORD. Exk. Fl. Java 2 (1912) 544. – *Sabia elliptica* (MIQ.) MIQ. Sum. (1861) 203, 521. – *Sabia javanica* (BLUME) CHEN *var. glabriuscula* (BLUME) CHEN, Sargentia 3 (1943) 61.

Evergreen woody climber or scandent shrub, up to 10 m. *Twigs* glabrous; flowering twigs up to 5 mm diam., glabrous or ± pubescent. *Buds* ovoid, up to 2 mm, acute; scales glabrous or with few hairs, ± ciliolate. *Leaves* elliptic-oblong to sublanceolate, 6–19 by 2–8(–10) cm, index 2–3(–4), pergamentaceous to pergamentaceous-coriaceous, above and beneath glabrous or with some hairs on midrib; base acute to rounded, apex acute, acuminate; nerves 4–7(–8) pairs, patent, curved to straight; petiole up to 2.5 cm, glabrous to sparsely pubescent, ± (fine-) wrinkled. *Cymes* arranged in an axillary, up to 12 cm long, glabrous to pubescent, thryrsoid inflorescence, subtended by bracts or sometimes by small leaves and then inflorescence up to 17 cm long; cymes up to 3 cm, forming a lax to dense cluster of 3–10(–12) flowers, subglabrous to pubescent. Bracts ovate to sublanceolate, up to 5 mm, subglabrous to more or less pubescent, ± ciliolate; bracteoles as bracts but smaller, or bracteoles minute or sepal-like and then situated near calyx; pedicel up to 4 mm. *Flowers* green to yellow or white. *Sepals* sometimes 6 (see bracteoles), ± ovate or broad-ovate, 0.75–1(–1.25) by 0.5–0.8(–1) mm, acute to obtuse, ± pubescent, ciliolate. *Petals* oblong, 2.5–3.5(–4) by 1–1.5 mm, obtuse, nerves up to 5, often dark-coloured and then conspicuous. *Stamens* (1–)1.25–1.5 mm; filament ± flattened, (0.75–)1–1.25 mm long, 0.25–0.5 mm wide; anther globular to ellipsoid, 0.2–0.3 mm, inflexed. *Disk* crown-shaped; ribs sometimes faint or absent. *Pistil* 0.8–1.2 mm; style ± conical, 0.2–0.5 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.6 by 0.5–0.7 mm, glabrous. *Drupelets* obovoid or sometimes globular, ± compressed, 9–11 by 9–10 mm, without persistent petals and stamens at the base; reticulate pattern often coarse and limited to the margin. *Embryo* with somewhat undulated or faintly folded cotyledons.

Distr. *Malesia*: Sumatra (East Coast Res., Indragiri, Lampongs), W. Java. In all *c.* 30 collections.

Ecol. Forests, at (20–)200–1500 m. *Fl. fr.* Jan.–Dec.

Vern. Java: *areuj bebentjojan, a. kahawatang, a. katjapi,* S.

Notes. *Sabia javanica* strongly resembles *S. pauciflora* from the Philippines, the Moluccas, New Guinea, and the Solomon Islands. It can be distinguished from that species by its often more-flowered cymes, its shorter style, and some other slight differences. Since both species are geographically separated, it was also possible to combine them into one species and give them the rank of subspecies. Although the differences are rather small, I believe that *S. javanica* and *S. pauciflora* represent two different, well-delimited, but very closely related species. Moreover, a reduction of both species to a single one would increase the variability of several taxonomic important characters, in consequence of which the delimitation with some other related species, like *S. parviflora* and *S. racemosa,* and possibly also *S. limoniacea,* would become less distinct. Finally, this might result into a far-going lumping and a reduction of all these species to, say, subspecies. Contrary to the situation in the extra-Malesian species *S. campanulata* WALL., however, in this case I believe that the differences between these taxa have reached a higher level already, resulting in the distinction of mutually closely related but ± well-delimited species, each with its own specific combination of characters.

In vegetative characters and in drupelets *S. javanica* resembles *S. racemosa* from Borneo. It can, however, easily be distinguished from that species by its more-flowered inflorescences and its floral characters, especially its petals.

3. Sabia limoniacea WALL. [Cat. (1829) *n.* 1000, *nom. nud.*] *ex* HOOK.*f.* & TH. Fl. Ind. 1 (1855) 210; WALP. Ann. 4 (1857) 139; BENTH. Fl. Hongk. (1861) 70; HOOK.*f.* Fl. Brit. India 2 (1876) 3; KURZ, J. As. Soc. Beng. 45, ii (1876) 204, *excl. syn. Sabia sp.* GRIFFITH (= *S. parviflora ssp. parviflora*); For. Fl. Burma 1 (1877) 300 (*'limonacea'*); FORBES & HEMSLEY, J. Linn. Soc. Bot. 23 (1886) 144; KING, J. As. Soc. Beng. 65, ii (1896) 454; PRAIN, Beng. Pl. 1 (1903) 246; BRANDIS, Indian Trees (1906) 194; DUNN & TUTCHER, Kew Bull. Add. Ser. 10 (1912) 68; RIDLEY, Fl. Mal. Pen. 1 (1922) 513; MERR. Lingnan Sc. J. 5 (1927) 19; KANJILAL *c.s.* Fl. Assam 1, 2 (1936) 326; CHEN, Sargentia 3 (1943) 56, f. 7; BISWAS, Pl. Darj. Sikkim Himal. 1 (1966) 261; VAN DE WATER, Blumea 26 (1980) 44, *f.* 6b, 8. – *Androglossum reticulatum* CHAMP. *ex* BENTH. Hook. J. Bot. Kew Gard. Misc. 4 (1852) 42; BENTH. Fl. Hongk. (1861) 70; CHEN, Sargentia 3 (1943) 58, *non S. reticulata* ELMER (1909). – *Sabia celastrinea* MUELL. in Walp., Ann. 6 (1865) 1269. – *Sabia malabarica* BEDD. Ic. Pl. Ind. Or. 1 (1874) 39, t. 177; HOOK.*f.* Fl. Brit. India 2 (1876) 2; BRANDIS, Indian Trees (1906) 194; GAMBLE, Fl. Pres. Madras 1 (1918) 254; CHEN, Sargentia 3 (1943) 48. – **Fig. 2, 3.**

Evergreen woody climber, up to 10 m. *Twigs* glabrous or sometimes sparsely pubescent; flowering twigs up to 5 mm diam., glabrous to lax-pubescent. *Buds* broad-ovoid to ovoid, up to 2.5 mm, acute; scales (sub)glabrous, often ciliolate. *Leaves* oblong-ovate to lanceolate, 4–18 by 1.5–6.5(–8) cm, index 2–4(–4.5), ± pergamentaceous-coriaceous, above and beneath glabrous or with some hairs especially on midrib; base acute to rounded, apex acute, sometimes obtuse, acuminate or not; nerves 5–9 pairs, ± patent, sometimes somewhat ascending, curved to straight; petiole up to 2.5 cm, glabrous to lax-pubescent. *Cymes* either solitary, axillary, subtended by small and often herbaceous leaves, or when either the leaves are fallen or the cymes are subtended by bracts arranged in an up to 15 cm long, glabrous to ± lax-pubescent or tomentellous, racemose to thyrsoid inflorescence, cymes up to 2 cm, 1–4(–6)-flowered; pedicels up to 7 mm; bracts oblong, up to 4 mm, glabrous to pubescent, ciliolate; bracteoles ovate to oblong, up to 1.75 mm, glabrous to pubescent, ciliolate, often situated near calyx. *Flowers* green to yellow or white. *Sepals* sometimes 6 or 7 (see bracteoles), broad-ovate to elliptic, 0.7–1.2(–1.5) by 0.6–1 mm, acute to rounded, glabrous to ± pubescent, ciliolate. *Petals* suborbicular to elliptic or ± obovate, 1.75–2.5 by 1.25–2 mm, obtuse to rounded, sometimes broad-acute, nerves 5, usually obscure. *Stamens* 1.5–2 mm; filament somewhat flattened, 1.25–1.75 by 0.3–0.4 mm; anther ellipsoid, 0.25–0.35 mm, inflexed. *Disk* crown-shaped, thin; ribs often faint or absent. *Pistil*

Fig. 2. *Sabia limoniacea* HOOK.*f.* & THOMS. *a*. Habit, ×2/3; *b*. ditto, with axillary cymes, ×2/3; *c*. open flower, ×4; *d*. petal and the opposed stamen, ×8; *e*. disk and pistil, ×8 (*a* & *c–e* C.W. WANG 79409; *b* WALLICH 1000).

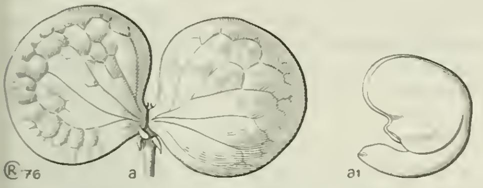

Fig. 3. *Sabia limoniacea* HOOK.*f.* & THOMS. *a*. fruit; *a'*. embryo, both ×1.5 (*a* POILANE 24769; *a'* POILANE 18918).

0.7–1.2 mm; style conical to cylindrical, 0.2–0.6 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.6 by 0.5–0.8 mm, glabrous. *Drupelets* globular to obovoid, strongly compressed, 11–14 by 10–13 mm, red to blue or black when fresh, without persistent petals and stamens at the base; reticulate pattern usually faint or absent, sometimes more prominent at the margin. *Embryo* with somewhat undulated cotyledons.

Distr. Continental SE. Asia (throughout India, Burma, Bangladesh, Thailand and Indochina to China); in *Malesia*: Malay Peninsula (incl. also P. Penang), Central Sumatra and Borneo (Sarawak), in all 7 collections.

Ecol. Thickets and forest, 300–1200 m altitude. *Fl.* Sept.–Jan., *fr.* Dec.–April.

4. Sabia parviflora WALL. in Roxb., Fl. Ind. 2 (1824) 310; G.DON, Gen. Hist. 2 (1832) 69; WALP. Rep. 1 (1842) 557; HOOK.*f.* & Th. Fl. Ind. 1 (1855) 210; WALP. Ann. 4 (1857) 139; HOOK.*f.* Fl. Brit. India 2 (1876) 2; STAPF, Trans. Linn. Soc. Lond. 4, 2 (1894) 142; BRANDIS, Indian Trees (1906) 194; LECOMTE, Fl. Gén. I.-C. 2 (1908) 2, *incl. var. harmandiana* LECOMTE, Bull. Soc. Bot. Fr. 54 (1907) 674; KANJILAL *c.s.* Fl. Assam 1, 2 (1936) 325; CHUN, Sunyatsenia 4 (1940) 242; MERR. Brittonia 4 (1941) 112; CHEN, Sargentia 3 (1943) 64; GAGNEP. & VIDAL, Fl. Camb. Laos, Vietnam 1 (1960) 16; BISWAS, Pl. Darj. Sikkim Himal. 1 (1966) 261; SEN GUPTA, Bull. Bot. Soc. Beng. 22, ii (1968) 196; HARA, Fl. E. Himal. 2 (1971) 74; SEN GUPTA, Rec. Bot. Surv. India 20, 2 (1973) 65; HARA & WILLIAMS, Enum. Fl. Pl. Nepal 2 (1970) 100; VAN DE WATER, Blumea 26 (1980) 48, f. 3c, 9. – *Sabia harmandiana* PIERRE, Fl. For. Coch. 5 (1897) pl. 360B; CRAIB, Fl. Siam. Enum. 1 (1926) 340. – *Sabia philippinensis* ROBINS. Bull. Torrey Bot. Club 35 (1908) 70; MERR. Enum. Philip. 2 (1923) 516; CHEN, Sargentia 3 (1943) 67.

For a complete synonymy, see VAN DE WATER (1980).

Evergreen climber or scandent shrub, up to 6 m. *Twigs* glabrous to laxly pubescent; flowering twigs up to 4 mm diam., glabrous to pubescent. *Buds* broad-ovoid to ovoid, up to 2 mm, acute; scales glabrous to short-pubescent, ciliolate. *Leaves* oblong to (sub)lanceolate, 3–12(–15) by 1–5 cm, index 2–4 (–4.5), ± pergamentaceous, above glabrous to subglabrous or sometimes sparsely pubescent especially when young, beneath glabrous to lax-pubescent especially on midrib; base acute to rounded, attenuate or not; apex acute, acuminate; nerves (5–) 6–9(–10) pairs, patent, straight or sometimes ± curved; petiole up to 1.5 cm, glabrous to mainly above lax-pubescent. *Cymes* solitary, axillary, 1.5–8 (–10) cm long, 4–25-flowered, sometimes widely spreading, lax, and with up to 35 or more flowers, glabrous to sparsely pubescent; pedicels up to 1 cm; bracts ovate to lanceolate, up to 2 mm or, when subtending a cyme up to 6 mm, subglabrous to pubescent, ciliolate; bracteoles as bracts. *Flowers* green to yellow or white. *Sepals* broad-ovate to ovate, 0.7–1.5 by 0.5–1 mm, acute to rounded, glabrous to pubescent, ciliolate. *Petals* elliptic-oblong to lanceolate or sometimes oblong-ovate, 2–4(–4.5) by 0.7–1.3 mm, acute to obtuse; nerves up to 7, dark-coloured or sometimes obscure. *Stamens* 1.2–2.25 (–2.5) mm; filament flattened, 0.9–2(–2.25) by 0.25–0.5 mm; anther ellipsoid to ovoid, 0.25–0.4 mm, often ± inflexed. *Disk* crown-shaped, usually thin; lobes often distinct, relatively long and narrow, sometimes short or margin of disk irregular; ribs often faint or absent. *Pistil* 1–2(–2.5) mm; style either absent or obscure, or conical, (0.75–)1–1.5 (–1.75) mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.4–0.7 by 0.5–0.75 mm, glabrous. *Drupelets* globular to somewhat obovoid, ± compressed, 7–9 by 6–8 mm, green to red or blue when fresh, without persistent petals and stamens at the base; reticulate pattern rather fine, but often inconspicuous or obscure. *Embryo* with faintly wrinkled cotyledons.

Distr. Widely ranging in SE. Asia from Nepal to China; in *Malesia*: N. Borneo (Sabah) and the Philippines (Luzon).

KEY TO THE SUBSPECIES

1. Style normally developed, distinctly conical, (0.75–)1–1.5(–1.75) mm long — **a.** *ssp.* **parviflora**
1. Style usually absent or obscure, the upper part of the pistil carpel-like, sometimes normally developed and then up to 0.75 mm — **b.** *ssp.* **philippinensis**

a. *ssp.* **parviflora** – *Sabia parviflora* WALL. – *Sabia harmandiana* PIERRE.

Leaves oblong, sometimes oblong-ovate to (sub) lanceolate, 3–12(–15) by 1–5 cm. *Cymes* 2–8(–10) cm long, 7–25-flowered, sometimes widely spreading, lax, and with up to more than 35 flowers. *Petals* oblong to lanceolate, sometimes oblong-ovate, 2.25–4(–4.5) by 0.7–1.25 mm. *Style* distinctly conical, (0.75–)1–1.5(–1.75) mm long.

Distr. SE. Asia; in *Malesia*: Borneo (Sabah), 9 collections.

Ecol. Roadsides, in thickets, and in forests, mainly 600–2000 m altitude. *Fl. fr.* probably throughout the year.

b. *ssp.* **philippinensis** (ROBINS.) VAN DE WATER, Blumea 26 (1980) 50. – *Sabia philippinensis* ROBINS. – **Fig. 4.**

Leaves oblong or oblong-ovate to lanceolate, 3–11 by 1–3.5 cm. *Cymes* 1.5–4.5 cm, 4–20-flowered. *Petals* elliptic-oblong to sublanceolate, 2–3.5 by 1–1.25 mm. *Style* absent or obscure and often carpel-like, sometimes normal-developed and then up to 0.75 mm. *Fruit*s not seen.

Fig. 4. *Sabia parviflora ssp. philippinensis* (ROBINSON) VAN DE WATER. *a.* & *b.* disk and pistil showing the absence of a style; *c.* a feebly developed one; all ×12 (*a* RAMOS 26973; *b* JACOBS 7402; *c* MERRILL 7708).

Distr. *Malesia*: Philippines (Luzon: Benguet Prov.), 11 collections.

Ecol. Forests, ?1000–2100 m. *Fl.* mainly Febr.–April.

Vern. *Baybayok, kopdas, uakal, udok*, Ig.

Notes. *Ssp. philippinensis* can be distinguished rather easily from *ssp. parviflora* by the absence of a normally developed style. In all the specimens I have seen (except one) the upper parts of the two carpels of each flower are not connate with each other and differentiated into a style as usual, but remain free and carpel-like, although the tip of each carpel is sometimes slightly stigmatic. Moreover, the margins of the upper part of a carpel are not fused, so that the upper half of each carpel remains open. Although this phenomenon is unique within the genus, I have reduced *S. philippinensis* to a subspecies of *S. parviflora* because it agrees very well with that species in all other main characters.

Like in all *Sabia* species the leaves are dark above, paler beneath, but in the present one the contrast is especially conspicuous. In *ssp. philippinensis* the pale margins and undersides of the leaves provide a useful character to distinguish vegetative specimens from those of *S. pauciflora*, another Philippine species

5. **Sabia pauciflora** BLUME, Mus. Bot. Lugd.-Bat. I (1851) 370; MIQ. Fl. Ind. Bat. 1, 2 (1859) 619; Fl. Arch. Ind. (1870) 72; *ibid.* (1871) pl. 32; CHEN, Sargentia 3 (1943) 61; VAN DE WATER, Blumea 26 (1980) 51. – *Sabia papuana* WARB. in K.Sch. & Laut., Fl. Deut. Schutzgeb. Südsee (1900) 425. – *Sabia reticulata* ELMER, Leafl. Philip. Bot. 2 (1909) 579; MERR. Enum. Philip. Fl. Pl. 2 (1923) 516; CHEN, Sargentia 3 (1943) 62.

Evergreen woody climber or scandent shrub, up to 20 m. *Twigs* glabrous; flowering twigs up to 5 mm diam., glabrous or sparsely pubescent. *Buds* ovoid, up to 2.5 mm, acute; scales glabrous to pubescent, (sub)ciliolate. *Leaves* oblong to sublanceolate, 5–14 (–18) by 2–6(–8) cm, index (2–)2.5–3.5(–4), above and beneath glabrous or with very few hairs on midrib, pergamentaceous; base acute to rounded, apex acute, acuminate; nerves (5–)6–8(–9) pairs, patent, straight to curved; petiole up to 2 cm, glabrous to sparsely pubescent. *Cymes* either arranged in an axillary, up to 12 cm long, glabrous to sparsely pubescent, racemose to thyrsoid inflorescence, subtended by bracts, or solitary, axillary, often subtended by small leaves, up to 3.5 cm, 1–4-flowered, glabrous to sparsely pubescent; bracts oblong to lanceolate, up to 3.5 mm, subglabrous to somewhat pubescent, (sub)ciliolate; bracteoles as bracts but smaller, or minute, or sepal-like and then often situated near calyx; pedicels up to *c.* 1 cm. *Flowers* green to yellow or white. *Sepals* sometimes 6 (see bracteoles), ovate to broad-ovate, 0.75–1.25 by 0.7–1 mm, acute to obtuse, glabrous to somewhat pubescent, (sub)ciliolate. *Petals* oblong, sometimes somewhat oblong-ovate, 2.5–4(–4.5) by (0.75–) 1–1.3(–1.5) mm, (narrow-)obtuse, sometimes subciliolate, nerves up to 5, sometimes dark-coloured and then conspicuous. *Stamens* (1–)1.25–1.75(–2) mm; filament flattened, (0.75–)1–1.5(–1.75) by 0.25–0.5 mm; anther globular to ellipsoid, 0.2–0.3 mm, inflexed. *Disk* crown-shaped; lobes often short or irregular; ribs sometimes faint or absent. *Pistil* 1.3–1.7 mm; style conical, 0.6–1 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.7 by 0.5–0.8 mm, glabrous. *Drupelets* ± globular, sometimes somewhat obovoid, compressed, 7.5–11 by 8–10(–11) mm, white to red or dark-blue when fresh, without persistent petals and stamens, reticulate pattern fine to rather coarse, sometimes indistinct, limited to the margin or not. *Embryo* with somewhat undulated or faintly folded cotyledons.

Distr. *Malesia*: Moluccas (Buru, Halmaheira, Batjan), Philippines (Luzon, Negros, Mindanao), New Guinea; Solomon Islands.

Ecol. Forests, from sea-level up to 2300 m. *Fl. fr.* throughout the year.

Uses. Fresh leaves eaten against wound fever in New Guinea.

Vern. Philippines: *bungoi, dadabu*, Bag.; New Guinea: *hambui*, Poio, Enga lang., *kubiakan*, Hagen-Chimbu, Yoowi dial., *mongolya ka*, Northern Prov., *pehkuma*, Mumuni, Orokaiva lang, *pipi*, E. Highlands, *pukhabu*, S. Highlands.

Note. This species is closely related to *S. javanica* from Java and Sumatra, but can be distinguished from that species by its always few-flowered cymes, its longer style, and its often ± globular drupelets (*S. javanica* often obovoid).

6. Sabia racemosa CHEN, Sargentia 3 (1943) 36, f. 2; VAN DE WATER, Blumea 26 (1980) 54.

Evergreen woody climber or scandent shrub, up to 6 m. *Twigs* glabrous; flowering twigs up to 4 mm diam., glabrous or somewhat short-pubescent. *Buds* ovoid, up to 1.5 mm acute; scales (sub)ciliolate or not. *Leaves* oblong or somewhat oblong-ovate, 6–25 by 2–10 cm, index 2–3(–3.5), pergamentaceous, glabrous or with some hairs on midrib, rarely beneath all over sparsely short-pubescent; base acute to rounded, apex acute, acuminate; nerves 4–8 (or 9) pairs, ± patent, curved to straight; petiole up to 2.5 cm, glabrous or with some very short hairs. *Cymes* arranged in an axillary, up to 8 cm long, glabrous to puberulous or short-tomentellous, racemose to thyrsoid inflorescence, subtended by bracts but often bracts fallen or sometimes leaf-like, cymes up to 1 cm, 1–4(–7)-flowered, glabrous to somewhat puberulous or short-tomentellous; bracts ovate to oblong, up to 3 mm, glabrous to somewhat pubescent, (sub)ciliolate; bracteoles as bracts but usually smaller, or minute and then often situated near calyx; pedicels up to 4 mm. *Flowers* (pale-)green to yellow. *Sepals* ± ovate to broad-ovate, 0.6–1.3 by 0.5–1 mm, acute to obtuse, glabrous to somewhat pubescent, (sub)ciliolate. *Petals* elliptic-oblong to ovate-lanceolate, 3.5–6.5 by (1.25–)1.5–2.5 mm, acute to obtuse, or ± acuminate, or gradually narrowed, nerves up to 7, thin but distinct. *Stamens* 1.2–2.2 mm; filament flattened, 1–2 by 0.2–0.5 mm; anther globular to ellipsoid, 0.2–0.3 mm, inflexed. *Disk* crown-shaped; lobes sometimes very short or indistinct; ribs sometimes faint or absent. *Pistil* 1–1.5 mm; style ± conical, 0.5–0.9 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.6 by 0.5–0.7 mm, glabrous. *Drupelets* obovoid, ± compressed, 10–12 by (7–)8–10 mm, white to pink or red when fresh, without persistent petals and stamens at the base; reticulate pattern faint to rather coarse, often limited to the margin. *Embryo* with somewhat to very wrinkled or folded cotyledons.

Distr. *Malesia*: Borneo.

Note. In vegetative characters and somewhat in the fruit this species resembles *S. javanica*. It differs, however, from that species in its inflorescence (few-flowered cymes) and in its floral characters, especially the petals.

Since the fruiting collections of *ssp. racemosa* bear only immature or damaged fruit, the description of the drupelets has mainly been based on the fruit of *ssp. kinabaluensis*.

The two subspecies can easily be distinguished from each other by the difference in the shape of their petals. Since they can be distinguished from each other only when flowers are available, the identification of most of the vegetative and fruiting specimens has mainly been based on the locality from where they have been collected.

KEY TO THE SUBSPECIES

1. Petals oblong-ovate to ovate-lanceolate, acute, somewhat acuminate or tapering to the apex **a.** *ssp.* **racemosa**
1. Petals elliptic-oblong to oblong, acute to obtuse **b.** *ssp.* **kinabaluensis**

a. *ssp.* **racemosa** – *Sabia racemosa* CHEN.

Sepals 0.6–1.1 by 0.5–1 mm. Petals oblong-ovate to ovate-lanceolate, (3.5–)4.5–6.5 by (1.25–)1.5–2.5 mm, acute, somewhat acuminate or tapering to the apex. Pistil 1–1.2 mm; style 0.5–0.7 mm long.

Distr. *Malesia*: Borneo (Kalimantan), 7 collections.

Ecol. Low altitudes, up to 100 m. *Fl. fr.* throughout the year.

b. *ssp.* **kinabaluensis** VAN DE WATER, Blumea 26 (1980) 55.

Sepals 0.9–1.3 by 0.6–1 mm. Petals elliptic-oblong to oblong, 3.5–5 by 1.5–2.5 mm, acute to obtuse. Pistil 1.2–1.5 mm high; style 0.6–0.9 mm long.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu), 15 collections.

Ecol. Forests, mainly at 800–1500 m altitude. *Fl. fr.* throughout the year.

7. Sabia sumatrana BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 370; MIQ. Fl. Ind. Bat. 1, 2 (1859) 619; Fl. Arch. Ind. (1870) 72; *ibid.* (1871) pl. 33; KING, J. As. Soc. Beng. 65, ii (1896) 454; RIDLEY, Fl. Mal. Pen. 1 (1922) 513; CHEN, Sargentia 3 (1943) 39; VAN DE WATER, Blumea 26 (1980) 56.

Evergreen woody climber, up to *c.* 3.5 m. *Twigs* glabrous; flowering twigs up to 4 mm diam., glabrous. *Leaves* elliptic to oblong, sometimes (sub) lanceolate, (5–)7–15(–18) by (1.5–)2.5–7(–10) cm, index 2–3(–4), pergamentaceous, above and beneath glabrous; base acute, apex acuminate to subcuspidate; nerves 5–7 pairs, patent, curved to straight; petiole up to 2 cm, glabrous. *Flowers* yellowish-green to white, either solitary, sometimes 2 or 3 together, axillary, or arranged in a thyrsoid, axillary, up to 6.5 cm long, glabrous inflorescence; pedicels up to 2.5 cm, glabrous, with few small budscales at the base when flowers solitary; bracts ± oblong-ovate, up to 1.5 mm long, glabrous, ciliolate; bracteoles as bracts. *Sepals* broad-ovate to ovate, 1.25–1.75(–2) by (0.75–)1–1.75 mm, acute to obtuse, glabrous, (sub)ciliolate or not. *Petals* oblong or ovate-lanceolate, *c.* 6–10 by 1.5–2.5 mm, sometimes the upper part somewhat channeled, tapering to the apex, acute to narrow-obtuse, nerves obscure. *Stamens* 3.5–7.5 mm; filament ± flattened, 3–7 by 0.4–0.75 mm; anther ellipsoid, 0.5–0.7 mm, upright. *Disk* short-cylindrical, small, the upper part not enclosing the base of the ovary and without lobes; ribs ± prominent. *Pistil* 3.5–c. 7 mm; style narrow-conical, 3–6 mm, ± half as long as the adjacent side(s) of the drupelet(s); ovary somewhat globular to subreniform, 0.5–0.8 by 0.7–1 mm, glabrous. *Drupelets* obovoid, somewhat compressed, 11–13 by 8–9 mm, white to blue when fresh, without persistent petals and stamens, reticulate pattern absent, often more or less rugged on the outside.

Distr. *Malesia*: Sumatra (W. Coast Res., Palembang), 7 collections.

Ecol. Forests, 60–1000 m altitude. *Fl.* May–Aug., *fr.* July–Sept., Febr.

Note. Only a few collections are available. For that reason no buds and embryos could be described, whereas the description of the flowers has partly been based on rather young ones.

Excluded

Sabia densiflora MIQ. Sum. (1861) 203, 520 = *Meliosma angulata* BLUME: K. & V. Bijdr. 9 (1903) 131 = *Meliosma simplicifolia* (ROXB.) WALP. *ssp. simplicifolia*: VAN BEUSEKOM, Blumea 19 (1971) 476; Fl. Males. 10^4 (1989) 698 (this issue).

Sabia floribunda MIQ. Sum. (1861) 203, 521 = *Meliosma angulata* BLUME: K. & V. Bijdr. 9 (1903) 131 = *Meliosma simplicifolia* (ROXB.) WALP. *ssp. simplicifolia*: *l.c.*

2. MELIOSMA

BLUME, Cat. (1823) 32; Rumphia 3 (1849) 196; MIQ. Fl. Ind. Bat. 1, 2 (1859) 612; BENTH. & HOOK.*f.* Gen. Pl. 1 (1862) 414; HOOK.*f.* Fl. Brit. India 2 (1876) 3; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 290; WARB. in E. & P., Nat. Pfl. Fam. 3, 5 (1895) 371; VAN BEUSEKOM, Blumea 19 (1971) 355. – *Millingtonia* ROXB. [Hort. Beng. (1814) 3, *nomen*] Pl. Corom. 3 (1820) 50, t. 254, *non* LINN.*f.* (1781), *nec* DONN (1807). – *Kingsboroughia* LIEBM. Vid. Medd. Nat. For. Kjøbenhavn 2 (1850) 67; WALP. Ann. 2 (1852) 834. – **Fig. 5–8, 10, 12.**

For a complete synonymy, see VAN BEUSEKOM (1971).

Evergreen or sometimes deciduous shrubs or trees, up to 42 m, 1 m diam., sometimes buttressed. *Twigs* more or less lenticellate, often with conspicuous leaf-scars. *Buds* densely pubescent. *Leaves* simple or imparipinnate with (sub)opposite leaflets, ending in 3 or 1 leaflet(s), in the latter case its petiolule articulated with the rachis; leaves or leaflets entire or dentate, with or without hairy domatia beneath; rachis and petioles, usually also petiolules, with a usually shallow and narrow, more or less conspicuous longitudinal groove above, usually with swollen base, articulately attached. *Inflorescence* terminal, sometimes axillary, a pyramidal panicle, poor to usually profuse, up to 4 times ramified, with alternate, articulately attached, often lenticellate axes. Bracts small, those of lower order usually soon caducous; cataphylls often present. Bracteoles absent, but sometimes one (or two) bracteole-like sepals present,

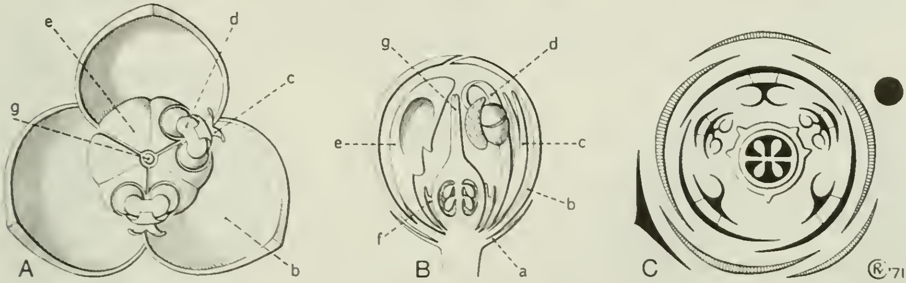

Fig. 5. Flower of *Meliosma*. *A*. Semi-diagrammatical sketch of flower (*subg. Meliosma*) with opened outer petals, but stamens still in bud position. *B*. Semi-diagrammatical length section of bud (*subg. Meliosma*). *C*. Diagram (*subg. Kingsboroughia* and *subg. Meliosma*). Names of the flower parts: *a*. sepals; *b*. outer petals; *c*. inner petals; *d*. fertile stamens; *e*. staminodes; *f*. disk; *g*. style.

lowered on the pedicel. *Flowers* numerous, sessile or short-pedicelled, small, bisexual. *Sepals* 5, by reduction sometimes 4, rarely 3, sometimes by addition of empty bracts seemingly more, up to *c*. 13, and together forming a kind of involucre, usually unequal and then mostly 3 about equal. *Petals* 5, episepalous, 3 outer ones more or less unequal, alternisepalous, mostly suborbicular and convex, rarely the largest one much wider than long and more or less reniform, the smaller ones irregularly shaped; 2 inner ones equal, much smaller, reduced, opposite the fertile stamens and more or less adherent to the base of the filaments, entire to bifid. *Disk* generally present, sometimes very reduced or absent, often irregularly shaped, as a rule with 5 more or less developed teeth, 4 of which paired, 1 unpaired, each pair opposite a fertile stamen. *Stamens* 5, epipetalous, 2 fertile, filament short, strap-shaped, flat, incurved at the top, abruptly terminating in a wide, varyingly shaped cup which bears two globose to elliptic transversely dehiscent anther-cells which are ripe in bud, springing back elastically when the flower opens; 3 staminodial, opposite the larger petals and more or less adherent to the base of these, deformed, broad, irregularly shaped, with 1 or 2 holes near the top in which fit the anther-cells of the fertile stamens, often coherent and forming a cup over the pistil. *Ovary* globose to ovoid or conical, 2-, very rarely 3-locular, apically contracted in a rather short, simple or 2-partible, cylindric or subulate to conical, rarely minute style, with simple or somewhat bifid, minute stigma. *Ovules* 2 (or 1) in each cell, more or less superimposed, attached to the partition, hemi-anatropous. *Fruit* a drupe, subglobose to pyriform, small, glabrous, with one stone; rarely two ovules instead of one per ovary develop, resulting in a didymous fruit; mesocarp pulpy, mostly thin; endocarp globose, pyriform, or semiglobose, 1-celled, stony to crustaceous, splitting in two valves, inside with a basilar rounded projection over which the seed is curved. *Vascular bundle* connecting pedicel and seed either running outside the endocarp wall (free in the pulpy mesocarp or in a groove on the ventral endocarp wall), or through a canal inside the endocarp

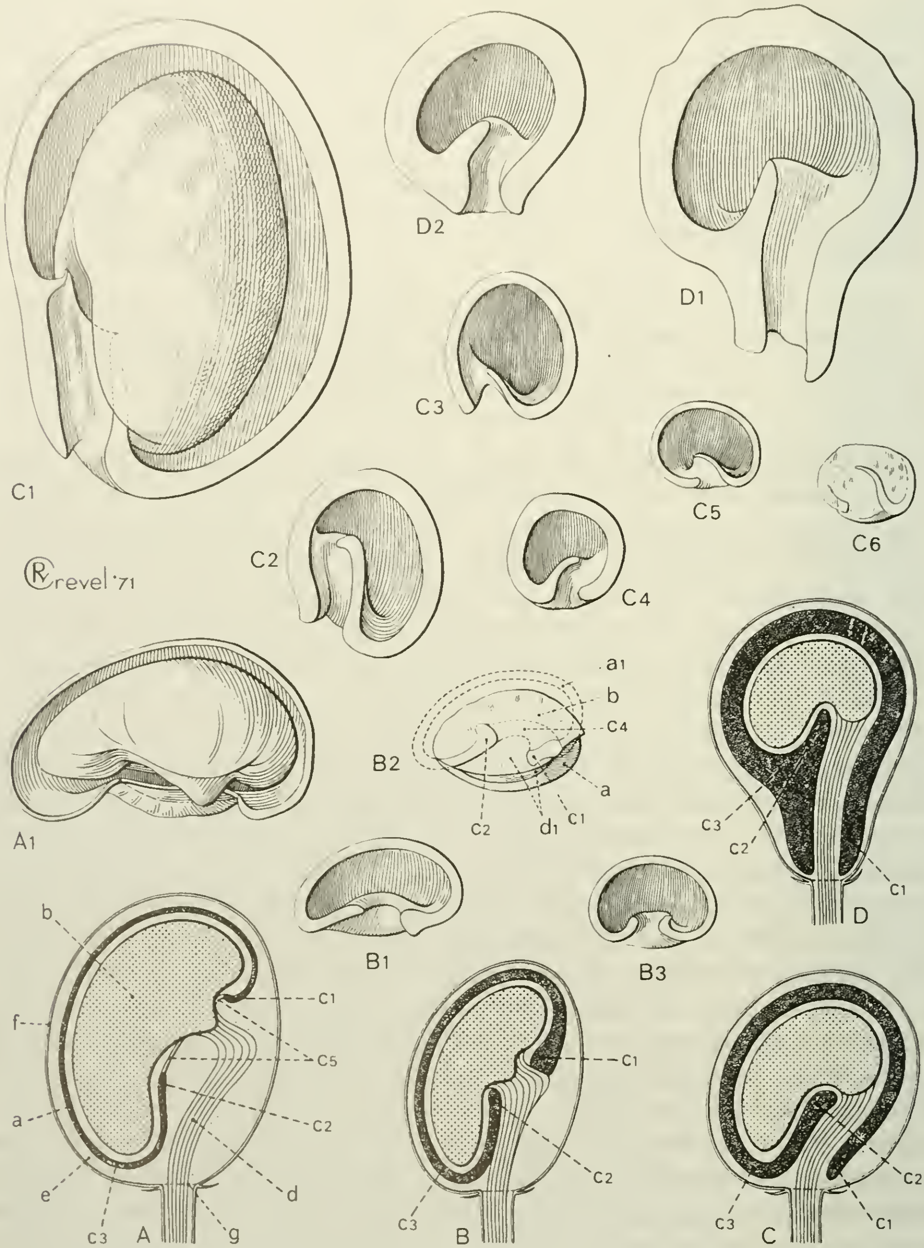

Fig. 6. Diagrammatical length sections of three types of fruit in *Meliosma*. *A. Subg. Kingsboroughia sect. Hendersonia*: vascular bundle running freely in the mesocarp. *B. Subg. Kingsboroughia sect. Kingsboroughia*: vascular bundle running in a groove of the endocarp, entering the wall through the ventral pore. *C. Subg. Meliosma sect. Meliosma*: similar to B, but the marginal canal lengthened through the endocarp. All ×3.

wall. *Seed* sub- to semiglobose, more or less concave at the ventral side, with membranous testa, without endosperm. *Embryo* with rather long, 2–3 times folded radicle and more or less folded cotyledons.

Distr. About 20–25 species, 15 of which in SE. Asia, and not more than *c.* 10 in Central and South America. In *Malesia*: 8 species.

The New World species belong to *Meliosma subg. Meliosma sect. Lorenzanea*, a section restricted to the New World; besides, there is one species of *subg. Kingsboroughia* which is widely spread in China but also occurs in Mexico (*M. alba* WALP.).

Correctly named fossils from the Tertiary are found widely distributed on the northern hemisphere, in Europe, Asia, and North America; see VAN BEUSEKOM, *l.c.* 384–424, fig. 16–18 (maps). The oldest known fossils, of both subgenera, date from the Eocene. All localities lie south of the 60° parallel of latitude and almost all beyond the present range of the genus. It is remarkable that still in the Pliocene the genus occurred in Europe, S. Russia, but no longer in North America. Only in southern Japan Pliocene fossils and recent species are found together.

Ecol. In primary and secondary forests, especially on hills and mountains up to *c.* 3300 m, but also in lowlands. All or almost all species prefer everwet to moist, tropical to subtropical conditions. Some are hardy in mild temperate climates; these are deciduous and grow flush-wise.

Morph. Trees, mostly small, sometimes shrubs, rarely mentioned to be subscandent, but *M. pinnata ssp. ferruginea* and *ssp. macrophylla* are recorded to reach 42 m height and *M. lanceolata* to reach 30 m by 1 m diam.

The margin of leaf or leaflet may be entire or dentate and is often variable. In saplings, watershoots and seedlings the margin is mostly dentate. In species with pinnate leaves the size of the leaflets mostly increases apically and their greatest width tends to shift towards the upper half. The leaves, when pinnate, have 1 or 3 top-leaflets; in the first case the petiolule of the top-leaflet has an articulation with the rachis.

The inflorescence consists of a racemosely arranged, rich-flowered panicle.

VAN BEUSEKOM (*l.c.* 361–364, fig. 2 & 3) amply discussed the peculiar flower structure. Although BAILLON assumed the flower to be basically 3-merous, he agrees with the majority of authors that it is 5-merous. The 3 outer petals are differently shaped from the 2 inner ones; the latter may be of the lanceolate or bifid type, and taxonomically their shape is important.

The structure of endocarp and seed (*l.c.* 364–369, fig. 4) is of great importance. The ovary contains 4 ovules but only one develops into a seed (exceptionally 2, resulting in an anomalous didymous fruit). The fruit is a drupe with rather thin, pulpy mesocarp and a stony to crustaceous endocarp, more or less globular to pyriform, smooth or often with a reticulate surface. When dehiscent, it splits into two valves, the plane of dehiscence usually marked by a ± prominent keel running all around the endocarp. At the ventral side there is a usually narrow pore through which the seed is connected with the vascular bundle towards the pedicel. There are two main types: 1) endocarps which only enclose the seed, whereas the vascular bundle connecting pedicel and seed is running outside the endocarp wall; 2) endocarps which enclose both seed and vascular bundle, the latter being situated in a marginal canal inside.

Taxon. The subdivision of the genus *Meliosma* is as follows:

1. Leaves simple or pinnate; when pinnate rachis terminating in 3 leaflets (anomalously 2 or 1). Sepals mostly 5. Outer petals narrowly imbricate, subrotund to broad-elliptic, all regularly shaped. Vascular bundle connecting pedicel and seed situated in a long or short marginal canal inside the endocarp. About 12 species in SE. Asia. *Spp. 1–7* .... *Subg.* **Meliosma**
 2. Leaves simple or pinnate. Ovary glabrous or pubescent. Endocarp wall relatively thin, not drawn out around the ventral perforation; endocarp mostly (sub)globose, sometimes semiglobose, or ellipsoid to obovoid. About 12 spp. in SE. Asia. *Spp. 1–7*.......... *Sect.* **Meliosma**
  3. Leaves simple. *Spp. 1 & 2*.......... *Subsect.* **Simplices** (WARB.) BEUS.
   4. Deciduous shrubs or small trees. Nerves all or almost all straight or almost straight. Continental Asia *Ser.* **Rectinervia** BEUS.
   4. Evergreen shrubs or trees. Nerves all or almost all distinctly ascending. *Spp. 1 & 2* *Ser.* **Curvinervia** BEUS.
  3. Leaves pinnate. *Spp. 3–7* .... *Subsect.* **Pinnatae** (WARB.) BEUS.
 2. Leaves simple. Ovary always glabrous. Endocarp wall relatively thick, more or less drawn out around the

ventral perforation which often gives the mostly (sub)globose endocarp a somewhat pyriform shape. About 10 species in Central and tropical South America .... *Sect.* **Lorenzanea** (LIEBM.) BEUS.

1. Leaves pinnate, petiolule of terminal leaflet articulate with the rachis. Sepals mostly 4. Outer petals widely imbricate, the largest one widely reniform, much wider than long, the smaller ones of irregular shape ± not wider than long. Vascular bundle connecting pedicel and seed situated outside the endocarp, either running in a groove at the ventral side or freely in the pulpy mesocarp *Subg.* **Kingsboroughia** (LIEBM.) BEUS.

5. Deciduous trees. Vascular bundle connecting pedicel and seed running in a ventral groove of the endocarp wall. Two species. SE. Asia and S. Mexico.................................. *Sect.* **Kingsboroughia**

5. Evergreen trees. Vascular bundle connecting pedicel and seed running freely in the mesocarp. One species. Malay Peninsula, N. Borneo. *Sp. 8* .... *Sect.* **Hendersonia** BEUS.

KEY TO THE SPECIES

1. Leaves simple. *Subg. Meliosma sect. Meliosma subsect. Simplices.*

2. Petioles 1/5–1/3 the length of the lamina. Panicles mostly axillary or sometimes ramiflorous, sometimes terminal. Inner petals bifid or entire. Endocarps ellipsoid to obovoid, with reticulate to smooth surface, rarely (sub)globose and then smooth, 6–14 cm diam.............................. **1. M. lepidota**

2. Petioles 1/20–1/5 the length of the lamina. Panicles always terminal. Inner petals always bifid. Endocarps always (sub)globose, always with reticulate surface, 3.5–8 mm diam. .... **2. M. simplicifolia**

1. Leaves pinnate. *Subg. Meliosma* and *subg. Kingsboroughia.*

3. Leaf-rachis terminating in 3 (sometimes 2, rarely 1) leaflets. Outer petals widely ovate to orbicular, entire. Endocarps inside with a marginal canal in which runs the vascular bundle connecting pedicels and seed. *Sect. Meliosma subsect. Pinnatae.*

4. Leaves 2–5(–6)-jugate; leaflets usually glabrous, sometimes (in Bornean specimens) pubescent beneath, above always with a prominent midrib. Inner petals (1.2–)1.5–2(–3) mm, entire to retuse or slightly bifid at apex. Ovary glabrous. Endocarps 0.7–2 cm diam. ....**3. M. sumatrana**

4. Leaves 2–23-jugate; leaflets glabrous or pubescent, midrib usually flat to sulcate above. Inner petals (0.3–)0.5–1(–1.5) mm, always distinctly and rather deeply bifid. Ovary glabrous or pubescent. Endocarps 0.2–1 cm diam.

5. Leaves (3–)6–18(–23)-jugate, with (10–)20–100 cm long rachis. Leaflets only very rarely with slight pubescence on midrib and nerves above. Panicles large and lax, 0.5–1.5 m, pendulous, usually suddenly bent down at the base, with up to 90 cm long primary side-axes which are never subtended by (small) leaves.

6. Leaflets in middle and upper part of the leaf elliptic to lanceolate, very rarely a few linear-lanceolate, index (0.5–)2–5(–7). Petiolules 2–30 mm ....**4. M. lanceolata**

6. Leaflets in middle and upper part of the leaf linear-lanceolate, index 5–10. Lateral petiolules absent or very short, to *c.* 1 mm ....**5. M. hirsuta**

5. Leaves 2–7(–9)-jugate, rachis up to *c.* 40(–60) cm. Leaflets usually more or less pubescent on midrib and nerves above, sometimes glabrous. Panicles lax to dense but not very large, 10–50(–70) cm, usually erect, sometimes ± pendulous, but almost never suddenly bent down at the base, with up to 35(–60) cm long side-axes which may be subtended by decrescent leaves.

7. Sepals pubescent. Outer petals glabrous. *Leaves* 2–3(–4)-jugate. Endocarps 7–8 mm diam. Small trees ....**7. M. sarawakensis**

7. Sepals glabrous (rarely with a few hairs), sometimes pubescent but then also outer petals pubescent. Leaves 2–7(–9)-jugate. Endocarps 3–9(–10) mm diam. Small to large trees.

8. Plants from Malesia except Sumatra and Java...................................**6. M. pinnata**

8. Plants from Sumatra and Java.

9. Leaflets pubescent at least on midrib and nerves, usually entire. Panicles often with decrescent leaves. Lowland and mountains up to 2500 m ....**6. M. pinnata**

9. Leaflets (sub)glabrous, usually (obscurely) dentate. Panicles without decrescent leaves. Mountains, 1300–2900 m...**4. M. lanceolata *f.* nervosa**

3. Leaf-rachis terminating in 1 (or 2) leaflets of which the short petiolule is always well markedly articulated with the rachis. Outer petals mostly widely reniform, or of irregular shape, mostly wider than long, with ± irregular margin and often emarginate. Endocarps inside without a marginal canal in which runs the vascular bundle, large, wider than 1 cm. Inner petals hardly or not incised at apex. *Subg. Kingsboroughia sect. Hendersonia*...**8. M. rufo-pilosa**

1. Meliosma lepidota BLUME, Rumphia 3 (1849) 199; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Sum. (1861) 203; VAN BEUSEKOM, Blumea 19 (1971) 451, *f.* 25. – **Fig. 7.**

For further synonyms, see under the subspecies; for a complete synonymy, see VAN BEUSEKOM (1971).

Evergreen shrub or tree, up to *c.* 15(–22) m. *Flowering twigs* pubescent when young, glabrescent. *Leaves* elliptic or obovate to lanceolate, 2–32 by 0.7–12(–18) cm, index (1.2–)1.5–3(–4), at the base acute, at apex acute to caudate, rarely obtuse, usually entire, sometimes remotely spinously dentate towards the apex, beneath sometimes pubescent on midrib and nerves, without domatia; nerves 7–15 pairs, usually strongly ascending, petioles usually rather long, 1–10 cm, 1/5–1/3 as long as the blade. *Panicles* usually axillary and erect, widely to usually narrowly pyramidal, 3–30(–200) cm, usually densely pubescent, bearing numerous solitary to crowded flowers which are sometimes spicately arranged; side-axes usually many, usually short, up to *c.* 15 (–40) cm, sometimes subtended by normal to small leaves; bracts ovate to linear-lanceolate, up to *c.* 2(–6) mm, usually densely pubescent. *Pedicels* absent or present, up to *c.* 3(–5) mm. *Mature buds* 1.5–3 mm diam. *Sepals* (4) 5, (round-)ovate, subequal, 1–2 mm, or the outer 1 or 2 smaller, often one lowered on the pedicel, all entire, ciliolate. *Outer petals* glabrous. *Inner petals* ± lanceolate and entire, or bifid, (0.6–)0.8–2.5 mm, glabrous or somewhat ciliolate at margin or tip, when bifid never with a central lobule. *Filaments* 0.7–1.5 mm. *Ovary* 0.5–1 mm, very exceptionally pubescent. *Fruit* (sub)globose, sometimes elliptic, when ripe 5–10 mm diam.; endocarp globose to ellipsoid, 6–8(–9) mm diam., usually with a slightly elevated rather fine reticulum; median keel distinct, more or less prominent; ventral pore whether or not sunken but never spouted.

Distr. SE. & E. Asia; in *Malesia* (with 4 subspecies): Sumatra, Malay Peninsula, W. Java, N. Borneo (Sabah), and the Philippines (Luzon, Mindoro).

Ecol. In evergreen forests under tropical or subtropical conditions, at medium to high altitudes; for details, see under the subspecies.

Notes. *Meliosma lepidota* displays a rather wide variation, especially in the ramification of its panicles which covers almost the whole range of possibilities found throughout *Meliosma.*

Within *M. lepidota* seven subspecies are recognized, four of which in Malesia. The differences between them are on the same level as in other subspecies in *Meliosma.* Transitional forms between these subspecies, however, occur in only a few cases, which is logical since there is perfect geographical isolation between most of them. See further the notes under the subspecies.

KEY TO THE SUBSPECIES

1. Inner petals distinctly bifid.
  2. Leaves 1.5–2(–2.5) times as long as wide; petiole 1/4–2/3 as long as the blade. Panicles 5–15 cm. Mature buds 2–2.5 mm diam. Endocarps ellipsoid to obovoid .... **d.** *ssp.* **kinabaluensis**
  2. Leaves (1.6–)2–3 times as long as wide; petiole (1/6–)1/5–1/3 (–1/2) as long as the blade. Panicles 3–30 cm. Mature buds 1.5–2(–2.2) mm diam. Endocarps long- to short-ellipsoid (always distinctly higher than wide) .... **a.** *ssp.* **lepidota**
1. Inner petals entire, usually lanceolate.
  3. Inner petals 2.5 mm. Panicles distinctly axillary or ramiflorous. Mature buds 2.5–3 mm diam. **b.** *ssp.* **dolichomischa**
  3. Inner petals 1–1.5 mm. Panicles terminal or crowded at the end of the twigs, rarely distinctly axillary. Mature buds 2–2.5 mm diam. **c.** *ssp.* **vulcanica**

a. *ssp.* **lepidota.** – *Meliosma lepidota* BLUME, Rumphia 3 (1849) 199; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Sum. (1861) 203; Illustr. (1871) 73. – *Meliosma pedicellata* K. & V. Bijdr. 9 (1903) 134; KOORD. Exk. Fl. Java 2 (1912) 545; Atlas 2 (1914) t. 379; BACKER & BAKH.*f.* Fl. Java 2 (1965) 144.

Leaves oblong, sometimes somewhat ovate-oblong, rarely elliptic, 5–26 by (1.5–)2–12 cm, entire, base acute, apex acute to caudate, glabrous when mature; nerves 8–12(–14) pairs; petiole 1.5–6 cm. *Panicles* axillary, rarely terminal or ramiflorous, often several together near the end of a branch, 3–30 cm, rather poor and lax, ramified up to the 2nd order; primary (essentially secondary!) side-axes short, up to *c.* 6(–10) cm. *Mature buds* 1.5–2 mm diam. *Inner petals* about halfway bifid, 0.7–1 mm; lobes rather narrow. *Endocarp* obovoid to ellipsoid, (8–)9–14 mm long, 5.5–8 mm diam., with or without rather wide and feeble reticulum; median keel distinct, more or less prominent, blunt to rather sharp, at one or both ends running out into a ventral, often somewhat beak-like processus; ventral pore rather wide, somewhat sunken.

Distr. *Malesia*: Sumatra (not uncommon in Aceh, Tapanuli, and West Coast), W. Java.

Ecol. Primary montane rain-forest; 900–2600 m altitude in Sumatra, 1050–1600 m in Java.

Field notes. Outer bark dark brown, finely corky, 0.5 mm; inner bark turning redbrown, 0.5 cm; wood ochre with reddish stripes.

Vern. Sumatra: *antuang, hontuang,* Batak lang., Toba, *kalompang bagèh,* Gn. Talamau.

Note. *Ssp. lepidota* is similar and probably most closely related to the adjacent *ssp. dolichomischa* and *ssp. kinabaluensis.* However, *ssp. lepidota* also

Fig. 7. *Meliosma lepidota* BLUME *ssp. dolichomischa* (VIDAL) BEUS. *a*. Flowering twig; ×0.5; *b*. half-opened flower, ×4.5; *c*. outer petal with adhering staminode; *d*. stamen with adhering inner petal, adaxial view; *e*. stamen, abaxial view; *f*. pistil with surrounding disk; *g*. ovary, length section, all ×9; *h*. fruit, ×1.5 (*a–g* HENDERSON SF 23488; *h* HENDERSON SF 23492).

shows a close resemblance to certain forms of *ssp. longipes* (MERR.) BEUS. from Vietnam, from which it can sometimes only be distinguished by the shape of the endocarp.

b. *ssp.* **dolichomischa** (VIDAL) BEUS. Blumea 19 (1971) 458, f. 25. – *Meliosma dolichomischa* VIDAL, Not. Syst. 16 (1960) 304. – *Meliosma monophylla* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 54 (1910) 40, *nom. illeg.*, *non* MERR. (1909); Fl. Mal. Pen. 1 (1922) 514; VIDAL, Not. Syst. 16 (1960) 306. – **Fig. 7.**

Leaves elliptic to oblong, 4–22 by 2–10 cm, entire, base mostly attenuate, apex usually cuspidate, glabrous or subglabrous, nerves 7–13 pairs, petiole (1–)3–10 cm. *Panicles* axillary or ramiflorous, solitary or a few together, 6–25 cm, rather poor and lax, ramified up to the 2nd or 3rd order; primary (essentially secondary!) side-axes up to *c.* 10 cm. *Mature buds* 2.5–3 mm diam. *Inner petals* lanceolate, *c.* 2.5 mm, entire, hooding over the stamens,

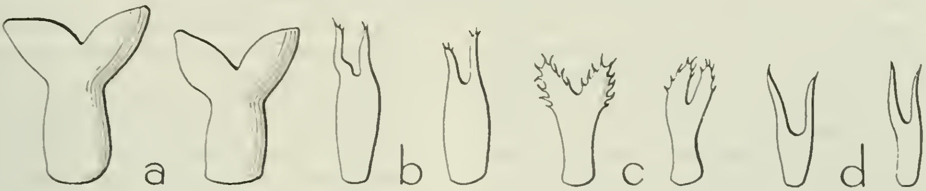

Fig. 8. Various types of inner petals in *Meliosma simplicifolia* WALP. *a. ssp. pungens* (WALP.) BEUS., *b. ssp. rigida* (SIEB. & ZUCC.) BEUS., *c. ssp. fruticosa* (BLUME) BEUS., *d. ssp. simplicifolia*; all ×18.

glabrous. *Endocarp* as in *ssp. lepidota.*

Distr. *Malesia*: Malay Peninsula (Pahang: Fraser's Hill, Cameron Highlands; Perak: Hermitage Hill, once).

Ecol. Primary montane rain-forest, *c.* 1200–1500 m altitude.

Field notes. Bark thick, red. Wood first white when cut, darkening to orange-brown. Leaves glaucous below.

c. *ssp.* **vulcanica** (MERR.) BEUS. Blumea 19 (1971) 460. – *Meliosma vulcanica* MERR. Philip. J. Sc. 11 (1916) Bot. 15; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Machilus nervosa* MERR. Philip. J. Sc. 4 (1909) Bot. 262; Enum. Philip. Fl. Pl. 2 (1923) 189; SALVORE & LAGRIMAS, Philip. J. For. 4 (1941) 309; *cf.* KOSTERM. Reinwardtia 5 (1960) 377; Bibl. Laur. 1 (1964) 919. – *Meliosma bontocensis* MERR. Philip. J. Sc. 20 (1922) 403; Enum. Philip. Fl. Pl. 2 (1923) 517; KOSTERM. Reinwardtia 5 (1960) 377.

Leaves obovate-oblong or oblong, 5–16 by 2–6 cm, base acute, apex acute to acuminate or sometimes rounded, glabrous or subglabrous; nerves 8–11 pairs; petiole 2–4 cm. *Panicles* terminal, sometimes axillary, 3–20 cm, rather profuse to poor, ramified up to the 3rd or 4th order; primary side-axes (mostly essentially primary!) up to *c.* 15 cm, usually subtended by normal to reduced leaves. *Mature buds* 2–2.5 mm diam. *Inner petals* lanceolate, 1–1.5 mm, entire, sometimes frayed at the tip. *Endocarp* subglobose, rather oblique, 6–7 mm diam., apart from a few ribs smooth, median keel distinct, rather prominent, at one end running out into a minute ventral processus; ventral pore somewhat sunken.

Distr. *Malesia*: Philippines (Luzon, Mindoro).

Ecol. Primary rain-forest, low altitude up to *c.* 2000 m.

Note. *Ssp. vulcanica* is the only subspecies of *M. lepidota* in which normal terminal panicles have been found. In general habit it is more similar to certain forms of *ssp. longipes* from Vietnam than to *ssp. squamulata* (HANCE) BEUS. from Taiwan or to *ssp. kinabaluensis* from Borneo, to which it is obviously less closely related.

d. *ssp.* **kinabaluensis** BEUS. Blumea 19 (1971) 455. – *Meliosma pedicellata* (*non* K. & V.) MERR. & PERRY, J. Arn. Arb. 20 (1939) 356.

Leaves elliptic, rarely oblong, 3–15 by 1.5–9 cm, usually entire, base acute to rounded and somewhat attenuate, cuspidate, above glabrous or ± pubescent on the midrib, subglabrous beneath, usually with a white waxy layer beneath, which gives a glaucous appearance; nerves 8–14 pairs; petiole 1–7.5 cm. *Panicles* terminal or axillary, solitary or a few together, 5–15 cm, rather poor and lax, ramified up to the 2nd (3rd) order; primary (essentially secondary!) side-axes up to *c.* 8 cm. *Mature buds* 2–2.5 mm diam. *Inner petals* halfway or somewhat less bifid, 1–1.2 mm; lobes rather narrow. *Endocarp* ± obovoid, *c.* 8 mm long, *c.* 6 mm diam., with rather wide and feeble reticulum; median keel only slightly elevated, blunt, at one end running out into a minute ventral processus; ventral pore wide, not sunken.

Distr. *Malesia*: Borneo (Mt Kinabalu).

Ecol. Montane forest, 1700–2700 m altitude.

Field notes. The lower surface of the leaves is often said to be white to light grey; in herbarium specimens indeed a whitish waxy layer can be observed often. The general colour of the leaves is reported to be glaucous.

Note. *Ssp. kinabaluensis* has a very low degree of variability, a characteristic which is also found in some other subspecies of *M. lepidota.* It is most similar to *ssp. dolichomischa* from the Malay Peninsula and to *ssp. lepidota* from Sumatra, with which it shares, amongst others, the more or less ellipsoid endocarp; all other subspecies have (sub)globose endocarps.

2. Meliosma simplicifolia (ROXB.) WALP. Rep. 1 (1842) 103; HASSK. Cat. Hort. Bog. (1844) 226; MIQ. Fl. Ind. Bat. 1, 2 (1859) 613; Sum. (1861) 203; VAN BEUSEKOM, Blumea 19 (1971) 462, f. 28. – *Millingtonia simplicifolia* ROXB. [Hort. Beng. (1814) 3, *nomen*] Pl. Corom. 3 (1820) 50, t. 254. – **Fig. 8, 10.**

For further synonyms, see under the subspecies; for a complete synonymy, see VAN BEUSEKOM (1971).

Evergreen shrub or tree, up to 20 m. *Leaves* elliptic or obovate to lanceolate, 3–50 by 1–18 cm, base cuneate, apex acute to acuminate, rarely caudate or rounded, entire to spinously dentate, sometimes with hairy domatia; nerves 7–25 pairs, ± ascending, sometimes looped; petiole 0.5–6(–7) cm, 1/20–1/3 as long as the blade. *Panicles* terminal, very rarely axillary, erect, lax to rather dense, widely to narrowly pyramidal, (4–)10–50(–60) cm, usually profusely branched up to the 2nd–4th order, bearing numerous solitary to crowded or glomerulate flowers which are usually spicately arranged; primary side-axes usually many, up to *c.* 25 cm, often subtended by leaves; bracts ovate to linear-lanceolate, up to *c.* 8 mm. Pedicels sometimes present, up to *c.* 3 mm. *Mature buds* (1–)1.5–3 mm diam. *Sepals* (4) 5, sometimes by addition of empty bracts seemingly more, up to 11(–13), (round-)ovate, equal or usually more or less unequal, the inner ones 0.7–2 mm, the outer one(s) smaller, often minute. *Inner petals* more or less deeply bifid, 0.5–1.5 mm, with glabrous, sometimes fimbriate or ciliolate lobes, never with a central lobule. Filaments 0.5–1.5 mm. *Ovary* 0.5–0.7(–1) mm. *Mature fruit* (sub)globose, 4–10 mm diam.; endocarp globose to subglobose, often depressed or oblique, 3–9 mm diam., with very vague to very strong and prominent reticulum; median keel more or less prominent; ventral pore somewhat sunken to somewhat spouted.

Distr. Continental SE. Asia (from Ceylon to China, Taiwan and S. Japan); in *Malesia*: Sumatra, Malay Peninsula, Borneo, Java, and Lesser Sunda Islands. Fig. 9.

Ecol. Subtropical to tropical forests, under various conditions, usually in mountains up to *c.* 3000 m, but also at sea-level. For details see under the subspecies.

Note. *Meliosma simplicifolia* is a very variable species, covering an enormous area in which it is adapted to many different habitats. It can be divided into eight well-marked subspecies, five of which centre in SW. Yunnan, and diverge over different parts of the area.

KEY TO THE SUBSPECIES

1. Sepals (4–)5.
   2. Panicles branched up to the 2nd (3rd) order, nearly always (very) densely tomentose; primary side-axes rarely subtended by leaves. Leaves sparsely to densely but always distinctly pubescent to tomentose, at least on midrib and nerves; without domatia. Style *c.* 1.5–2 times as long as the ovary .... **b.** *ssp.* **rigida**
   2. Panicles branched up to the (2nd) 3rd or 4th order, sparsely pubescent to moderately tomentose; lower primary side-axes often subtended by normal to small or reduced leaves. Leaves glabrous to densely pubescent, rarely tomentose, with or without domatia. Style about as long as the ovary or shorter.
      3. Leaves with or without domatia; midrib on the upper side of the full-grown leaf glabrous or nearly so, more or less prominent, rarely flat. Inner petals with entire lobes, which are sometimes slightly fimbriate or ciliolate at the very tips. Endocarps 3.5–5(–7) mm diam. **a.** *ssp.* **simplicifolia**
      3. Leaves with or without domatia; midrib on the upper side of the full-grown leaf more or less but distinctly pubescent, ± impressed to flat. Inner petals usually with fimbriate, rarely entire lobes which are rarely minutely ciliolate at the very tips. Endocarps (4.5–)5.5–8 mm diam. **c.** *ssp.* **fruticosa**
1. Sepals (8–)9–11(–13). Leaves usually with domatia. Endocarps 3.5–5.5 mm diam. **d.** *ssp.* **pungens**

a. *ssp.* **simplicifolia**. – *Millingtonia simplicifolia* ROXB. [Hort. Beng. (1814) 3, *nomen*] Pl. Corom. 3 (1820) 50, t. 254; Fl. Ind. 1 (1820) 103; NEES, Flora 8 (1825) 106; GRIFF. Not. Pl. As. (1854) 162; Ic. Pl. As. (1854) t. 442; ANON. Ic. Roxb. 4 (1970) 40, t. 20; VAN BEUSEKOM, Blumea 19 (1971) 476. – *Meliosma simplicifolia* WALP. Rep. 1 (1842) 103; HASSK. Cat. Hort. Bog. (1844) 226; THW. Enum. Pl. Zeyl. (1858) 59; MIQ. Fl. Ind. Bat. 1, 2 (1859) 613; Sum. (1861) 203; Illustr. (1871) 73; BEDD. Fl. Sylv. 3 (1871) 77; BRANDIS, For. Fl. (1874) 116; HOOK. *f.* Fl. Brit. India 2 (1876) 5; KURZ, J. As. Soc. Beng. 45, ii (1876) 204; Fl. Burma 1 (1877) 301; Trim. Fl. Ceyl. 1 (1893) 315; PRAIN, Bengal Pl. 1 (1903) 246; BRANDIS, Indian Trees (1906) 194; MERR. Contr. Arn. Arb. 8 (1934) 95; Brittonia 4 (1941) 110; VIDAL, Not. Syst. 16 (1960) 307. – *Meliosma angulata* BLUME, Rumphia 3 (1849) 197; WALP. Ann. 2 (1852) 224; K. & V. Bijdr. 9 (1903) 131; KOORD. Exk. Fl. Java 2 (1912) 545; Atlas 2 (1914) t. 378; BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30; VIDAL, Not. Syst. 16 (1960) 304. – *Sabia densiflora* MIQ. Sum. (1861) 203, 520. – *Sabia floribunda* MIQ. *l.c.* 203, 521; KURZ, J. As. Soc. Beng. 39, ii (1870) 74. – **Fig. 8d.**

Leaves obovate-oblong to -lanceolate, up to *c.* 50 by 18 cm, base cuneate, apex acute to short-cuspidate, beneath often with domatia; nerves 8–23 pairs. *Panicles* rather lax, 10–45 cm, branched up to the 3rd or 4th order; axes sparsely to densely pubescent but never tomentose, the lower primary ones subtended by leaves. *Flowers* more or less crowded to solitary, (sub)sessile; mature buds 1.5–2 mm diam. *Sepals* 5 (4). Inner petals 0.6–0.8 mm, usually over halfway bifid, lobes more or less divergent, narrow, glabrous, sometimes slightly fimbriate or ciliolate at the very tips. *Style* about as long as ovary or shorter.

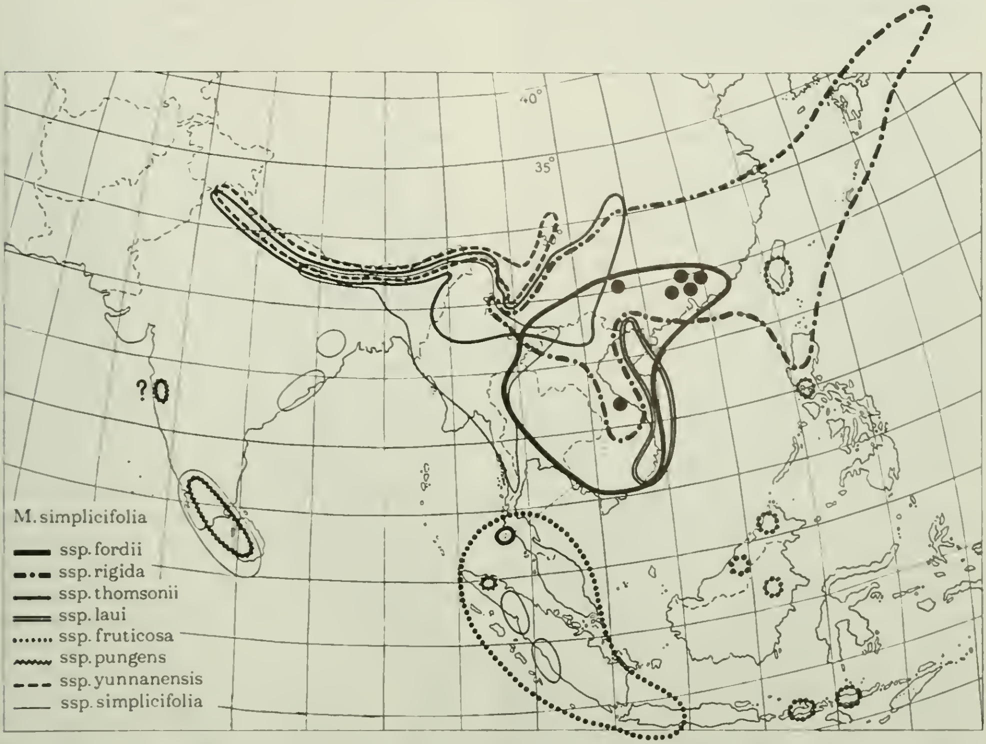

Fig. 9. Generalized areas of the subspecies of *Meliosma simplicifolia* WALP.

Endocarps subglobose, usually rather oblique, nearly triangular at ventral view, 3.5–5(–7) mm diam., with more or less prominent, rather coarse reticulum; median keel usually very prominent, at one end sometimes running out into a minute ventral processus; ventral pore somewhat or not sunken, not spouted.

Distr. Widely distributed in continental SE. Asia; in *Malesia*: northern half of Sumatra, W. Java (not found since BLUME's time). Fig. 9.

Ecol. Primary and secondary evergreen forest, from sea-level up to *c.* 1200(–1500) m altitude. It is often reported to occur along watercourses.

Vern. Sumatra: *medang sungu*, M, *simulingga, sumpa mana belawah*, Karo, *kayu gadis*, West Coast.

Note. A rather uniform, well recognizable subspecies all over its area.

b. *ssp.* **rigida** (SIEB. & ZUCC.) BEUS. Blumea 19 (1971) 473. – *Meliosma rigida* SIEB. & ZUCC. Abh. K. (Bayer.) Ak. Wiss. M.-Ph. Kl. München 4, 2 (1845) 153; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 93; Cat. Mus. Bot. 1 (1870) 23, *incl. var. angustifolia* MIQ., *nomen*; MAXIM. Bot. Jahrb. 6 (1884) 60; FORBES & HEMSLEY, J. Linn. Soc. Bot. 23 (1886) 145, *p.p., excl. M. pungens*; DUNN, J. Linn. Soc. Bot. 38 (1908) 358; HAYATA, Ic. Pl. Formos. 1 (1911) 161; DUNN & TUTCH. Kew Bull. Add. Ser. 10 (1912) 68; CHUN, Sunyatsenia 1 (1933) 180; HAND.-MAZZ. Beih. Bot. Centralbl. 52 (1934) 166; KANEH. Formos. Trees ed. 2 (1936) 416, f. 372; CUFOD. Oest. Bot. Z. 88 (1939) 267, *incl. var. patens*; HARA, Enum. Sperm. Japon. 3 (1954) 121; MAKINO, Ill. Fl. Jap. (1954) 348, f. 1044; WALKER, Imp. Trees Ryukyu Is. (1954) 200, f. 121; HOW, Acta Phytotax. Sin. 3 (1955) 444; GAGNEP. & VIDAL, Fl. Camb. Laos & Vietnam 1 (1960) 47, *in obs.*; LIU, Ill. Lign. Pl. Taiwan 2 (1962) 925, f. 762; LI, Woody Fl. Taiwan (1963) 503; OHWI, Fl. Japan (1965) 613. – *Quercus jama-buwa* SIEB. *in sched. ex* MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 93, *nom. inval.* – *Meliosma pungens auct. non* (W. & A.) WALP.: HOOK. *f.* Fl. Brit. India 2 (1876) 4, *p.p., quoad pl. Japon.* – *Meliosma patens* HEMSLEY *ex* FORBES & HEMSLEY, J. Linn. Soc. Bot. 23 (1886) 145. – *Meliosma harmandiana* PIERRE, Fl. For. Cochinch. 5 (1897) t. 360. – *Meliosma glomerulata* REHD. & WILS. in Sarg., Pl. Wils. 2

Fig. 10. *Meliosma simplicifolia* WALP. *ssp. fruticosa* (BLUME) BEUS. *a*. Fruiting twig, ×0.5; *b*. detail of leaf undersurface, ×2.5; *c*. endocarp, in different positions, ×2.5 (*a–c* KADIM & NOOR 395).

(1914) 203. – *Meliosma loheri* MERR. Philip. J. Sc. 10 (1915) Bot. 38; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma pannosa* HAND.-MAZZ. Anz. Ak. Wiss. Wien M.-N. Kl. 58 (1921) 179; HOW, Acta Phytotax. Sin. 3 (1955) 442; GAGNEP. & VIDAL, Fl. Camb. Laos & Vietnam 1 (1960) 50, *in obs., p.p.* – *Meliosma costata* CUFOD. Oest. Bot. Z. 88 (1939) 266; HOW, Acta Phytotax. Sin. 3 (1955) 444; GAGNEP. & VIDAL, Fl. Camb. Laos & Vietnam 1 (1960) 45; VIDAL, Not. Syst. 16 (1960) 304. – *Meliosma evrardii* GAGNEP. Not. Syst. 14 (1952) 273, *p.p.*

Leaves usually obovate-oblong to obovate-lanceolate, sometimes oblong to lanceolate, 4–25(–32) by 1.5–8(–11) cm, base long-cuneate to acute, apex acute to cuspidate, without domatia; nerves 7–19 pairs. *Panicles* lax to rather dense, 10–30 cm, branched up to the 2nd (3rd) order; axes more or less tomentose, sometimes woolly-pubescent, the primary ones only exceptionally subtended by small leaves. *Flowers* more or less crowded, usually in dense glomerules, sessile; mature buds 1.7–2.2 mm diam. *Sepals* 5 (4). *Inner petals* 0.6–0.8 mm, usually less than halfway bifid, lobes hardly or not divergent, rather narrow, fimbriate or ciliolate at the tips. *Style* about (1.5–)2 times as long as ovary. *Endocarps* (sub)globose, not or not much oblique, (3.5–)4–5 mm diam., with fine reticulum; median keel blunt to rather sharp, hardly to distinctly prominent, often at one end running out into a minute ventral processus or tubercle; ventral pore not sunken, often somewhat spouted.

Distr. Widely distributed in continental SE. Asia, incl. China, Laos, S. Vietnam (only at Hué), Taiwan (incl. Pescadores), Ryu Kyu Islands, Japan; in *Malesia*: Philippines (Luzon: Mountain Province). Fig. 9.

Ecol. In evergreen broad-leaved or laurophyllous forests, on different soils; in dry as well as in wet places; altitude usually 100–1000 m, but in Luzon reported from 1200–1600 m.

Field notes. Bark grey, smooth. Branches brown. Leaves lustrous green above, sometimes glaucous beneath. Fruit blue-purple to purplish black.

Vern. Philippines: *gahatan*, If., Luzon; *lasuit*, Bondoc dial.

Notes. *Ssp. rigida* is variable in quite some characters in its area outside Luzon, for instance in the degree of pubescence, leaf shape, and dentation. In continental SE. Asia the area of *ssp. rigida* borders on or overlaps the areas of five or six other subspecies of *M. simplicifolia*, which substantially adds to the chance of confusing them, several specimens being hybrids. It is probable that these subspecies are ecologically isolated to a large extent and thus contact between them is prevented.

Quercus gilva var. procera BLUME, Mus. Bot. Lugd.-Bat. 1 (1850) 306, was included in the synonymy of *M. rigida* by HARA, *l.c.*, but I found it to belong to *Quercus gilva* BLUME.

c. *ssp.* **fruticosa** (BLUME) BEUS. Blumea 19 (1971) 477, f. 28. – *Meliosma fruticosa* BLUME, Rumphia 3 (1849) 198; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Illustr. (1871) 73; K. & V. Bijdr. 9 (1903) 133; KOORD. Exk. Fl. Java 2 (1912) 545. – *Meliosma elliptica* HOOK.*f.* Fl. Brit. India 2 (1876) 5, *p.p., excl. Sabia floribunda* MIQ.; KING, J. As. Soc. Beng. 65, ii (1896) 456; RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 33 (1900) 67; Fl. Mal. Pen. 1 (1922) 514; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 364. – *Meliosma lancifolia* HOOK.*f.* Fl. Brit. India 2 (1876) 5; KING, J. As. Soc. Beng. 65, ii (1896) 456; RIDLEY, Fl. Mal. Pen. 1 (1922) 514. – *Meliosma monophylla* MERR. Philip. J. Sc. 4 (1909) Bot. 286; Enum. Philip. Fl. Pl. 2 (1923) 517; VIDAL, Not. Syst. 16 (1960) 306. – **Fig. 8c, 10.**

Leaves usually oblong to lanceolate, 5–40(–45) by 2–15 cm, base acute, apex acute to acuminate, densely pubescent on midrib and sometimes on nerves and lamina, beneath glabrous to tomentose, sometimes with domatia; nerves 7–25 pairs. *Panicles* usually lax, sometimes more dense, 10–50 cm, branched up to the 3rd (4th) order; axes pubescent to short-tomentose, the lower primary ones subtended by small leaves or not. *Flowers* more or less crowded to solitary, (sub)sessile; mature buds 1.5–2 mm diam. *Sepals* 5 (4). *Inner petals c.* 0.7 mm, about halfway or somewhat less bifid; lobes divergent or not, usually rather narrow, more or less fimbriate, sometimes entire. *Style* about as long as ovary or shorter. *Endocarps* globose or ± ellipsoid, (4.5–)5.5–8 mm diam., with rather wide, coarse reticulum; median keel prominent, at one end often running out into a minute ventral processus; ventral pore not or not much sunken, not spouted.

Distr. S. Peninsular Thailand (Surat) and Taiwan; in *Malesia*: common in the Malay Peninsula and Sumatra; W. Java, Lesser Sunda Islands (Sumbawa, Flores), Borneo (Central Sarawak, Kinabalu, W. Kutai), and the Philippines (Luzon). Fig. 9.

Ecol. Primary rain-forest, on various soil types, reported to occur on limestone, sand, volcanic loam, and andesite; altitude from sea-level up to 2400 m.

Field notes. Bark smooth, grey to brown, lenticellate, paperthin. Inner bark pale brown to dark brownred. Wood reddish to redbrown. Fruit yellow to pale red when ripening, dark red to brown when ripe.

Vern. (all once noted). Malay Peninsula: *bua palu*, Selangor, *medang kerkulu*, *mengading*, Malacca; Sumatra: *lelagan*, Gajo lang., Aceh, *kaju djarap*, *k. gasir*, *k. si raga*, Asahan, *kaju ardong ardong*, Toba, *kabung kabung*, Tapanuli, *masadih pajo*, Simalur, *kendung*, Palembang, *redjang*, Djambi; Java: *ki tiwu*, Preanger; Flores: *kaju sar*; Philippines: *malaligas*, Tag.

d. *spp.* **pungens** (WALL. *ex* W. & A.) BEUS. Blumea 19 (1971) 466. – *Millingtonia pungens* WALL. *ex* W. & A. Edinb. New Phil. J. 15 (1833) 178; Prod. 1 (1834) 115; WIGHT, Ic. 3 (1845) t. 964/3. – *Meliosma pungens* (WALL. *ex* W. & A.) WALP. Rep. 1 (1842) 423; Ann. 1 (1848) 135; THW. Enum. Pl. Zeyl. (1858) 59; BEDD. Fl. Sylv. 3 (1871) 77; *ibid.* t. 160; MERR. Contr. Arn. Arb. 8 (1934) 94; VIDAL, Not. Syst. 16 (1960) 306. – *Meliosma wightii* PLANCH. *ex* BRANDIS, For. Fl. (1874) 116;HOOK.*f.* Fl. Brit. India 2 (1876) 4. – **Fig. 8a.**

Leaves elliptic to oblong, sometimes lanceolate, 5–20(–30) by 2–8(–10) cm, without or with some distant teeth, acute to rounded at the base, acute to acuminate at the apex, usually distinctly pubescent on midrib and sometimes on nerves above, sparsely to moderately pubescent beneath especially on midrib and nerves, usually with domatia; nerves 7–18 pairs. *Panicles* lax to dense, (5–)10–55 cm, branched up to the 2nd (3rd) order; axes rather coarse, densely short-tomentose, the lower primary ones almost always subtended by small leaves. *Flowers* crowded in dense glomerules, sessile; mature buds 2–2.5 mm diam. *Sepals* (8–)9–11(–13). *Inner petals c.* 1 mm, slightly bifid; lobes divergent, wide, glabrous. *Style* about as long as ovary. *Endocarps* (sub)globose, often rather irregular, 3.5–5.5 mm diam., with usually lax reticulum; median keel distinct but not very prominent, not running out into a ventral processus; ventral pore hardly or not sunken, not spouted.

Distr. Sri Lanka and Deccan Peninsula; in *Malesia*: N. Sumatra (Gajo Lands, Takengon), one collection. Fig. 9.

Ecol. Mountain forest, 1500–2000 m altitude.

3. **Meliosma sumatrana** (JACK) WALP. Ann. 1 (1848) 135; MIQ. Fl. Ind. Bat. 1, 2 (1859) 617; Sum. (1861) 203; Illustr. (1871) 75; HOOK.*f.* Fl. Brit. India 2 (1876) 6; KOORD. Minah. (1898) 408; Suppl. Cel. 2 (1922) 7, t. 56; *ibid.* 2 (1922) 28; MERR. Enum. Born. (1921) 363; Enum. Philip. Fl. Pl. 2 (1923) 518; Contr. Arn. Arb. 8 (1934) 95; MERR. & PERRY, J. Arn. Arb. 20 (1939) 357; VAN BEUSEKOM, Blumea 19 (1971) 485. – *Millingtonia sumatrana* JACK, Mal. Misc. 2 (7) (1822) 30; HOOK. J. Bot. 1 (1834) 378; MERR. J. Arn. Arb. 33 (1952) 236. – *Meliosma nitida* BLUME, Cat. (1823) 32; NEES, Flora 8 (1825) 106; HASSK. Tijd. Nat. Gesch. Phys. 10 (1843) 139; Cat. Hort. Bog. (1844) 226; BLUME, Rumphia 3 (1849) 202, t. 169, *incl. var. tridenta* BLUME, *var. cerasiformis* BLUME *et var. splendens* BLUME; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 617; Sum. (1861) 203, 520; Illustr. (1871) 74; KING, J. As. Soc. Beng. 65, ii (1896) 457; K. & V. Bijdr. 9 (1903) 117; KOORD. Exk. Fl. Java 2 (1912) 546, f. 81; Atlas 2 (1914) 377; RIDLEY, Fl. Mal. Pen. 1 (1922) 515; BAKER *f.* in RENDLE, J. Bot. 62 (1924) Suppl. 30; BURK. & HEND. Gard. Bull. Str. Settl. 3 (1925) 364; HEYNE, Nutt. Pl. (1927) 1002; MERR. & PERRY, J. Arn. Arb. 20 (1939) 357; Backer & BAKH.*f.* Fl. Java 2 (1965) 145. – *Irina integerrima* BLUME, Bijdr. (1825) 231, *non* HASSK. Pl. Jav. Rar. (1848) 284 (*'Irine'*); WALP. Rep. 1 (1849) 416; BLUME, Rumphia 3 (1849) 202, *in syn. sub M. nitida.* – *Millingtonia nitida* SCHULT. & SCHULT. Syst. Veg. Mant. 3, add. 2 (1827) 250; DIETR. Syn. Pl. 1 (1839) 103. – *Meliosma confusa* BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 616; Sum. (1861) 203, 520; Illustr. (1871) 74. – *Meliosma cuspidata* BLUME, Rumphia 3 (1849) 202; MIQ. Fl. Ind. Bat. 1, 2 (1859) 617; Illustr. (1871) 74; HALL.*f.* Meded. Rijksherb. 1 (1910) 2; MERR. Enum. Born. (1921) 362. – *Meliosma pinnata* (*non* WALP.) KOORD. Minah. (1898) 408. – *Meliosma diepenhorstii* VALET. Ic. Bog. 2 (1904) 195, t. 150. – *Meliosma elmeri* MERR. Pl. Elm. Born. (1929) 177. – *Meliosma philippinensis* MERR. & PERRY, J. Arn. Arb. 20 (1939) 357.

Evergreen tree, up to 15–20(–25) m. *Leaves* 2–5(–6)-jugate; rachis terete, 6–50 cm, including the up to *c.* 25(–30) cm long petiole, up to *c.* 10(–15) mm across, rarely slightly pubescent, usually with distinctly swollen base; leaflets usually elliptic to lanceolate, (3–)5–35(–50) by (1.5–)2.5–15(–20) cm, base cuneate to rounded, shortly narrowed into the petiole, apex acuminate to caudate, usually entire, beneath rarely more or less pubescent, without domatia; midrib slightly prominent above; nerves (5–)7–13(–19) pairs, ascending, nearly always looped and joined; petiolules very short or up to *c.* 6 cm, usually distinctly swollen at the base especially in older leaves. *Panicles* usually terminal, usually narrowly, sometimes widely pyramidal, 7–50(–75) cm, usually profusely branched up to the 4th order, rather stiff and coarse, puberulous, bearing numerous crowded flowers; primary side-axes usually rather short, up to *c.* 30 cm, the lower ones exceptionally subtended by small to reduced leaves; bracts ovate to narrowly triangular, up to *c.* 6 mm, ± puberulous. *Pedicels* absent or short, up to *c.* 2 mm. *Mature buds* (1.5–)2–3(–3.5) mm diam. *Sepals* 5 or 4, ovate, unequal, the inner 3 or 4 *c.* 1–2 mm, the outer 1 or 2 usually smaller, often minute, sometimes lowered on the pedicel, sometimes puberulous outside, especially the outer ones, with entire or 2- or 3-lobed, often ciliolate margin. *Outer petals* glabrous. *Inner petals* elliptic to lanceolate or strap-shaped with wide-truncate tip, (1.2–)1.5–2(–3) mm, acute to slightly bifid or retuse and frayed at the tip. *Ovary*

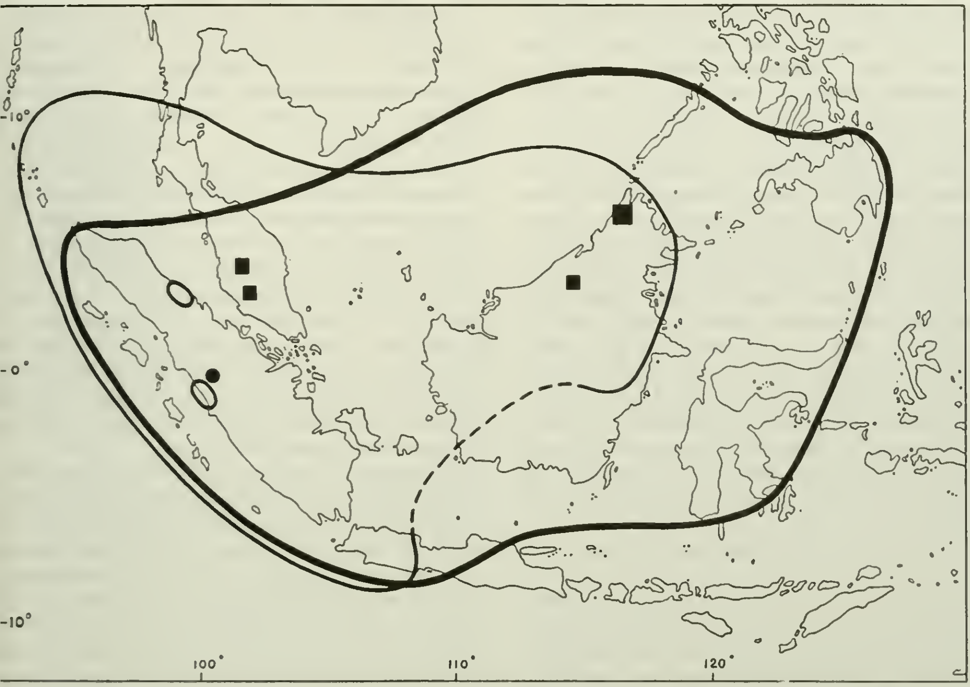

Fig. 11. Generalized areas of *Meliosma sumatrana* (JACK) WALP. (thick line) and *M. lanceolata* BLUME (thin line); the small oval areas indicate the localities of *M. lanceolata var. polyptera* (MIQ.) BEUS. The distribution of *M. hirsuta* BLUME is indicated by a dot, that of *M. rufo-pilosa* HEND. by squares.

0.5–1 mm, glabrous. *Fruit* globose to short-ellipsoid, when ripe 1–3 cm diam., with rather thick spongy to pulpy mesocarp; endocarp ellipsoid, sometimes nearly globose, 0.7–2 cm diam., with almost smooth to somewhat lumpy surface, often with a few faint to sharply prominent ribs; median keel distinct, slightly elevated to sharply prominent, at one end often running out into a more or less prominent curving, at the other end sometimes into a minute tubercle; ventral pore mostly rather wide, usually somewhat sunken.

Distr. *Malesia*: Sumatra (incl. Nias, Batu & Sipora Is., Banka), Malay Peninsula (incl. Penang I.), Anambas Is., W. half of Java, throughout Borneo, Sulawesi, and the Philippines (Mindanao, Palawan). Common. Fig. 11.

Ecol. Primary and secondary lowland and montane rain-forest, up to *c.* 2200 m altitude. Found on various soils, fertile as well as infertile, in dry to wet localities, in dense to open forests, by streams as well as on hilltops and ridges.

Field notes. Often a crooked tree, irregularly branched. Trunk sometimes with small buttresses. Bark surface grey to brown, smooth, with lenticels, often with shallow fissures, sometimes said to be dimpled, patchy or scaly. Inner bark 0.5–1 cm thick, soft, fibrous, light yellow or dirty white, soon turning pink, brownish, reddish, or rusty after exposure. Sapwood said to be whitish, yellowish, creamy orange, or brownish. Sap without special smell or taste. Leaves bright green on both sides. Flower colour varying from white, cream, or greenish, to partly or entirely pinkish to red. Fruit first yellow, then yellow with red to red when ripe; pulp white, turning quickly blood-red on exposure, finally becoming black, sweetish to tasteless.

Uses. The species was proposed by KOORDERS & VALETON, *l.c.*, for reforestation purposes. In Mindanao the triturated bark and leaves are several times reported to be in use as a medicine applied for wounds, to soothe itchy skin or – charred and put in water – against tympanites. It was also said to be used in agricultural rituals. The fruits are many times reported to be edible.

Vern. Malay Peninsula: *pa-ang*, Saki name, and *mengading besar*, both from Pahang, *buah mata ikan*, Temuan, Selangor, *pokoh haran*, Negri Sembilan, *kaju kahwa kantu, membuloh, pokoh grab* *jantan, p. mata gajah, p. pai gigi, p. pinang plandog, p. ravoa antoo, pudding utan*, Malacca, *pelantu*; Sumatra: *laon, si paturut, sringkut*, Karo country; *kaju durung durung, k. ining ining*, Tapianuli, *tampa bussie*, Priaman, *marazat*, Mt Kerinci; Java: *ki tiwu (landuk) (bodas)*, S, *ki huut*, Udjong Kulon; Borneo, Sarawak: *bulitiap*, Kenyah dial., *malak*, Kayan dial., *bulu manuk*, Iban, *bitonok*, Dyak; Sabah: *bung lai*, Sungai, *gapas gapas, kapas kapas, keriyan*, Dusun, *illulal, limpangot, tunjang*, Murut; SE. Borneo: *tambalilin, tandao*, Dyak, Tidung dial.; *djangkanggunung*, Bandjar lang., Riom dial.; Sulawesi: see KOORD. Minah. (1898) 408; *enggolokia*, W. Toradja dial., *putu putu, situi*, Tobela lang., Malili, *pobumengo*, Gorontalo; *dama*, Torai dial., Menado; Philippines: *carabo-rabo, daborabo, kadabudabo, karabu-rabu, magobaylung, mahagkol, yagabogan*, Mbo, Buk., *bentinguasay, gepulu*, Zamboanga, *waat*, Cebuano, Mt Apo, *salalab*, Moro dial., *garong, gimbingimbing*, Sub., *sumagasa*, Bag.

Notes. *Meliosma sumatrana* is very constant in its discriminative characters (especially the prominent midrib and entire inner petals), but there is nevertheless some geographical variation, especially in the northern part of Borneo (Sarawak, Sabah). As general tendencies may be noticed that towards the centre of the area leaflets and fruits increase in size and dentate leaflets become more common. Moreover, the number of leaflet pairs decreases when the leaflets are larger.

Sterile hybrids between *M. sumatrana* and *M. pinnata ssp. ridleyi* are rarely found (Sabah).

DOCTERS VAN LEEUWEN (Zoocecidia Neth. East Indies, 1926, 339, f. 612) described a leaf-gall on a specimen from Sulawesi. This type of galls (usually ball-shaped, *c.* 4 mm, ending in a short mucro, and surrounded by a calyx-like circumvallation) is rather commonly met with in this species, not only in specimens from Sulawesi, but also from Borneo, Sumatra, and the Malay Peninsula. The galls do not only occur on the lower surface of the leaflets, but occur also on the upper surface, and on rachis and petiolules, often very many crowded together.

4. **Meliosma lanceolata** BLUME, Cat. (1823) 32; NEES, Flora 8 (1825) 106; HASSK. Cat. Hort. Bog. (1844) 226; BLUME, Rumphia 3 (1849) 200, t. 168, *p.p., incl. var. pendula* BLUME, *var. membranacea* BLUME, *var. chartacea* BLUME *et var. obliqua* BLUME; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Sum. (1861) 203, 520; Illustr. (1871) 74, *p.p.*; HOOK.*f.* Fl. Brit. India 2 (1876) 7; KING, J. As. Soc. Beng. 65, ii (1896) 458; RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 33 (1900) 67; K. & V. Bijdr. 9 (1903) 125; HALL.*f.* Med. Rijksherb. 1 (1910) 2, *in obs.*; KOORD. Exk. Fl. Java 2 (1912) 546; MERR. Enum. Born. (1921) 363; RIDLEY, Fl. Mal. Pen. 1 (1922) 516, f. 51; BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30; CRAIB, Fl. Siam. Enum. 1 (1926) 340; RIDLEY, Kew Bull. (1926) 63; MERR. Pl. Elm. Born. (1929) 176; HOCHR. Candollea 6 (1936) 467, *incl. var. genuina* HOCHR.; BACKER & BAKH.*f.* Fl. Java 2 (1965) 145; VAN BEUSEKOM, Blumea 19 (1971) 489. – *Millingtonia lanceolata* SCHULT. & SCHULT. Syst. Veg. Mant. 3, add. 2 (1827) 250; DIETR. Syn. Pl. 1 (1839) 103. – *Meliosma polyptera* MIQ. Sum. (1861) 203, 520; Illustr. (1871) 73. – *Meliosma levis* KING, J. As. Soc. Beng. 65, ii (1896) 457; RIDLEY, Fl. Mal. Pen. 1 (1922) 515. – *Meliosma nervosa* K. & V. Bijdr. 9 (1903) 129; KOORD. Exk. Fl. Java 2 (1912) 546; Atlas 2 (1914) t. 376; Fl. Tjibodas 2 (1923) 158; MERR. & PERRY, J. Arn. Arb. 20 (1939) 359, *in obs.*; BACKER & BAKH.*f.* Fl. Java 2 (1965) 145.

Evergreen tree, up to *c.* 25(–30) m. *Twigs* often with conspicuous leaf-scars. *Leaves* (3–)7–18(–25)-jugate; rachis terete, (10–)30–100 cm, including the 5–30 cm long petiole, up to *c.* 8 mm diam., usually with distinctly swollen base, usually ± lenticellate; leaflets usually oblong to lanceolate, hardly or not asymmetrical, 5–20 by 2–7 cm, not or only slightly increasing in size towards the top of the leaf, often the lowermost pairs much smaller, base usually acute to rounded, apex acuminate to cuspidate, glabrous to moderately pubescent, always without domatia; midrib usually deeply impressed above; nerves 5–16 pairs, ascending, looped. *Panicles* terminal, nearly always pendulous and lax, rarely erect (then also small), pyramidal, usually large, (15–)50–150 cm and profusely branched up to the 3rd order, ± pubescent, bearing numerous glomerulate or crowded flowers which are usually spicately arranged, the glomerules often with regular space; main axis terete, often bent down abruptly at the base; primary side-axes many, usually long, up to *c.* 90 cm, never subtended by leaves; bracts ovate to narrowly triangular, up to *c.* 5 mm, ± pubescent. *Pedicels* absent, up to *c.* 1 mm. *Mature buds* 1.5–2 mm diam. *Sepals* 5 (4), ovate, more or less unequal, the inner 3 or 4 *c.* 1 mm, the outer 2 or 1 usually much smaller, often minute and sometimes slightly keeled, sometimes somewhat lowered on the pedicel, all glabrous, and with an entire margin. *Outer petals* 1.5–2 mm. *Inner petals* about halfway bifid, *c.* 0.6 mm, with ciliolate, rarely glabrous lobes, usually with a minute central lobule. *Filaments c.* 1 mm. *Ovary* (0.5–)0.7(–1) mm, usually densely, sometimes sparsely pubescent, rarely glabrous. *Fruit* (sub)globose, when ripe 7–10 mm diam.; endocarp subglobose, often somewhat depressed to applanate at the ventral side, usually strongly oblique, (5–)6–9 mm diam., with usually distinct, rather coarse, mostly sharply prominent reticulum; median keel sharp and prominent, at one end often running out into a small to minute ventral processus or tubercle; ventral pore not or not much sunken.

Distr. Nicobar Is., extreme South of Peninsular Thailand; in *Malesia*: Sumatra (incl. Simalur, Batu, and Banka Is.), W. Java, Borneo (northern half). Not uncommon, scarce in Borneo. Fig. 11.

Ecol. Primary and often secondary forests, at low and medium altitudes, occasionally ascending to 1500 m, *f. nervosa* to 2900 m, on various soil types.

Field notes. Outer bark grey to brown, rather smooth, later with longitudinal cracks, thin, often lenticellate. Inner bark 0.5–1 cm, several times said to be (light) red, orange brown, or redbrown, also dirty white and then turning rusty after exposure. Wood soft, white or pale yellow to light yellow brown. Crown low, irregular and lax, with few usually crooked branches. The conspicuous large leaves are rather crowded at the end of the twigs. Leaflets when young red-brownish. *Flowers* white or yellowish to pink or red (sometimes different colours in the same panicle). *Fruit*s first dirty red, then bluish black when ripe.

Vern. Malay Peninsula: *medang siri*, Malacca; Sumatra: *kabung kabung (blumut)*, Batak lang., Simelungun dial., *bulung manuk*, Batak lang., Karo dial., *sondang, sontang*, Timor on N. Sumatra, *kaju buluk hudjan*, Lampong, *angké foluh pajo, silaora, surin sito bulung, tutun surin or seulang (pajo), t. tungké ali*, Simalur I.; W. Java: *ki tiwu*, S, often used as well for *M. pinnata* and *M. sumatrana* (also with the addition *lalaki, mindi bodas* or *persawon*), *surén leuweung*, S. See also under *var. lanceolata f. nervosa* and *var. polyptera*.

Notes. *Meliosma lanceolata* is generally very well characterized by its large pendulous panicles and its long leaves with many usually lanceolate leaflets. Nevertheless it shows a wide variation especially in number but also in shape and size of the leaflets and the panicles. On the islands west of Sumatra (Simalur, Nias, Batu) specimens are found with normal inflorescences but only 3–5-pinnate leaves, and elliptic, sometimes subrotund, large leaflets. Transitions to this extreme are common. There is another deviating form, however, which takes a separate position. It has many small, mostly lanceolate leaflets which otherwise do not differ from those of *M. lanceolata*. Also the panicles agree with that species. In view of the wide variability in the leaves of *M. lanceolata*, I prefer to include it here and I have reduced it to a variety. The varieties and forms can be distinguished as follows:

a. *var.* **lanceolata**.

Leaves (3–)6–18-jugate, with up to *c.* 100 cm long rachis (including the petiole); leaflets elliptic to lanceolate, medium-sized to large, 5–20(–25) by (2–)2.5–7(–10) cm, index (1.5–)2–5(–6), without or with teeth, glabrous or pubescent.

Notes. In the lowland parts of its area *var. lanceolata* is nearly always very constant in the main characters. Mainly at higher elevations, however, forms occur which deviate considerably, often to such an extent that it is very difficult to separate them from less typical forms of the otherwise well distinct *M. pinnata ssp. ferruginea* and *ssp. ridleyi*; in a few cases, especially when the material is incomplete, this can only be done by a specialist who is thoroughly acquainted with habitus and variability of both species.

For instance, a form with erect, unusually short panicles (sometimes only 15 cm long) and other deviating characters may be met with. It occurs mainly in the montane zone; transitional forms are found lower, and these show a more or less gradual fading of typical *lanceolata* characters. Specimens of this mountain form have been described from Java by KOORDERS & VALETON, *l.c.*, as *M. nervosa*. In my opinion this species should be reduced to the rank of a form only; see below.

forma **lanceolata**.

Leaves (3–)6–18-jugate, with elliptic to lanceolate, glabrous to pubescent leaflets. Panicles pendulous, usually much longer than 50 cm. Inner petals ciliolate. Ovary pubescent.

forma **nervosa** (K. & V.) BEUS. Blumea 19 (1971) 493. – *M. nervosa* K. & V., *vide supra*.

Leaves not more than 8(–10)-jugate, with usually elliptic glabrous leaflets. Panicles erect, shorter than *c.* 50 cm, minimum length *c.* 15 cm. Inner petal mostly glabrous. Ovary pubescent to glabrous.

Distr. *Malesia*: Sumatra (G. Leuser, G. Talakmau), W. Java.

Ecol. Mountain forest, 1300–2900 m altitude. The tree can reach a height of 30 m by 1 m diam.

Vern. Java: *ki tjermèh badak, ki tjermèh beureum*, S.

b. *var.* **polyptera** (MIQ.) BEUS. Blumea 19 (1971) 492. – *M. polyptera* MIQ., *vide supra*.

Leaves 12–25-jugate, with at most 50 cm long rachis (including the petiole); leaflets oblong to linear-lanceolate, small, 4–11 by 1–2 cm, entire, glabrous.

Distr. *Malesia*: Sumatra (Asahan, W. Coast). Fig. 11.

Ecol. At low altitudes.

Vern. Sumatra: *badar badar*, Lubuk Alung, *tandikat batu*, Priaman, *simarpapàhu*, Huta Padang.

5. Meliosma hirsuta BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 616; Sum. (1961) 203; Illustr. (1871) 74;


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MERR. Enum. Born. (1921) 363; VAN BEUSEKOM, Blumea 19 (1971) 493.

Evergreen small tree, *c.* 5 m. *Leaves* 15–20-(or probably more-)jugate; rachis 50–100 cm including the 10–20 cm long petiole, up to *c.* 6 mm across, more or less hirsute, usually with distinctly swollen base, sometimes sparsely lenticellate; leaflets (sub) sessile, those in medium and upper part of the leaf linear-lanceolate, 10–20(–25) by (1.5–)2–3 cm, index 5–10, the lower ones (ovate-)lanceolate to ovate, gradually decreasing in length towards the base of the leaf, up to only *c.* 3 cm, base rounded to acute, sometimes slightly oblique, apex acuminate to caudate, with entire to remotely spinously dentate margin, thin-chartaceous, above glabrous except for some pubescence on the midrib, beneath moderately to sparsely hirsute especially on midrib and nerves, without domatia; midrib above flat to slightly impressed; nerves widely apart, (5–)8–12 pairs, ascending, looped and joined into a distinct marginal nerve situated at 2–4 mm from the margin; venation distinct, wide, reticulate; petioles absent or up to *c.* 1 mm, terminal one often longer, up to *c.* 8 mm, densely hirsute, not swollen at the base. *Panicles* and *flowers* as in typical *M. lanceolata*, but sepals up to *c.* 1.5 mm. *Fruit* as in *M. lanceolata*.

Distr. *Malesia*: Sumatra (West Coast: G. Malintang), only one collection. Fig. 11.

Notes. This species was by BLUME erroneously recorded to occur in S. Borneo.

Meliosma hirsuta is doubtless very closely related to *M. lanceolata*, but very well distinct by its leaf characters.

See also *Pimela angustifolia* under the dubious species.

6. Meliosma pinnata (ROXB.) MAXIM. Bull. Ac. Imp. Sc. St. Pétersb. 12 (1867) 64; Mélanges 6: 263. – *Millingtonia pinnata* ROXB. Fl. Ind. 1 (1820) 103. – **Fig. 12.**

For further synonyms, see under the subspecies; for a complete synonymy, see VAN BEUSEKOM (1971: 494).

Evergreen, sometimes deciduous tree, small to up to *c.* 42 m. *Twigs* often with conspicuous leaf-scars. *Leaves* 2–11-jugate; rachis terete, (2–)5–40(–60) cm, including the up to *c.* 15(–25) cm long petiole; leaflets usually ovate, elliptic, or obovate to ovate-oblong, sometimes lanceolate, often asymmetric, 1.5–25 by 1–10 cm, usually increasing in size towards the top of the leaf, base usually acute to rounded, rarely slightly emarginate, apex acuminate to cuspidate, entire or dentate, usually slightly to densely pubescent, often with domatia; midrib flat to impressed above; nerves 3–15 pairs, ascending, looped; petiolules up to 5 cm, terminal one usually longest, not or not much swollen at the base. *Panicles* terminal, erect, sometimes somewhat pendulous, dense to lax, widely to narrowly pyramidal, 10–55(–70) cm, usually profusely branched up to the 4th order, bearing numerous solitary to usually crowded flowers; primary side-axes usually many, up to 35(–60) cm, lower ones sometimes subtended by small to reduced leaves; bracts ovate to narrowly triangular, up to *c.* 5(–10) mm, more or less pubescent. *Pedicels* absent or up to 3(–4) mm. *Mature buds* (1.5–)2(–3) mm diam. *Sepals* 5 or 4, ovate, unequal, the 3 or 4 inner ones 1–1.5 mm, the outer 1 or 2 usually smaller, often minute, sometimes lowered on the pedicel, sometimes slightly keeled, glabrous or pubescent outside, all entire, usually ciliolate. *Outer petals* usually glabrous. *Inner petals* more or less deeply bifid, (0.3–)0.6(–1) mm, glabrous, ciliolate or fimbriate at the tips, often with a minute central lobule, often frayed at the tips. *Filaments c.* 1 mm. *Fruit* (sub)globose to obovoid, when ripe (3–)4–10(–11) mm diam., with thin mesocarp; endocarp (sub)globose, oblique or not, (2.5–)3.5–9(–10) mm diam., with more or less prominently reticulate surface; median keel usually distinct and more or less prominent, at one end sometimes running out into a small to minute processus or tubercle, and sometimes curving outwards at the other end; ventral pore usually rather narrow, whether or not sunken.

Distr. Throughout SE. Asia, from Sri Lanka and China to Japan; throughout *Malesia* as far as New Guinea (incl. New Britain). Fig. 13.

Ecol. Forests under moist tropical to subtropical, sometimes warm-temperate conditions, on various soils, from sea-level up to *c.* 3000 m altitude.

Notes. *Meliosma pinnata* covers a very large area in which it has developed a complex and wide variation pattern. It can be divided up into nine well-marked subspecies. Four of these are widely distributed, whereas five have a limited distribution. The first group, the subspecies *arnottiana*, *ridleyi*, *macrophylla* and *ferruginea*, are considered primary

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Fig. 12. *Meliosma pinnata* (ROXB.) WALP. *ssp. macrophylla* (MERR.) BEUS. *a.* Flowering twig, × 0.33; *b.* half-opened flower, × 5; *c.* outer petal with adhering staminode; *d.* flower with outer petals removed and stamens snapped backward; *e–g.* stamen with adhering inner petal, in different positions; *h.* pistil with surrounding disk; *i.* ovary, length section, all × 10; *j.* ripe fruit, × 3; *k–l.* endocarp in different positions, × 3 (*a–i* SULIT PNH 32941, *j–l* KOSTERMANS 6911).

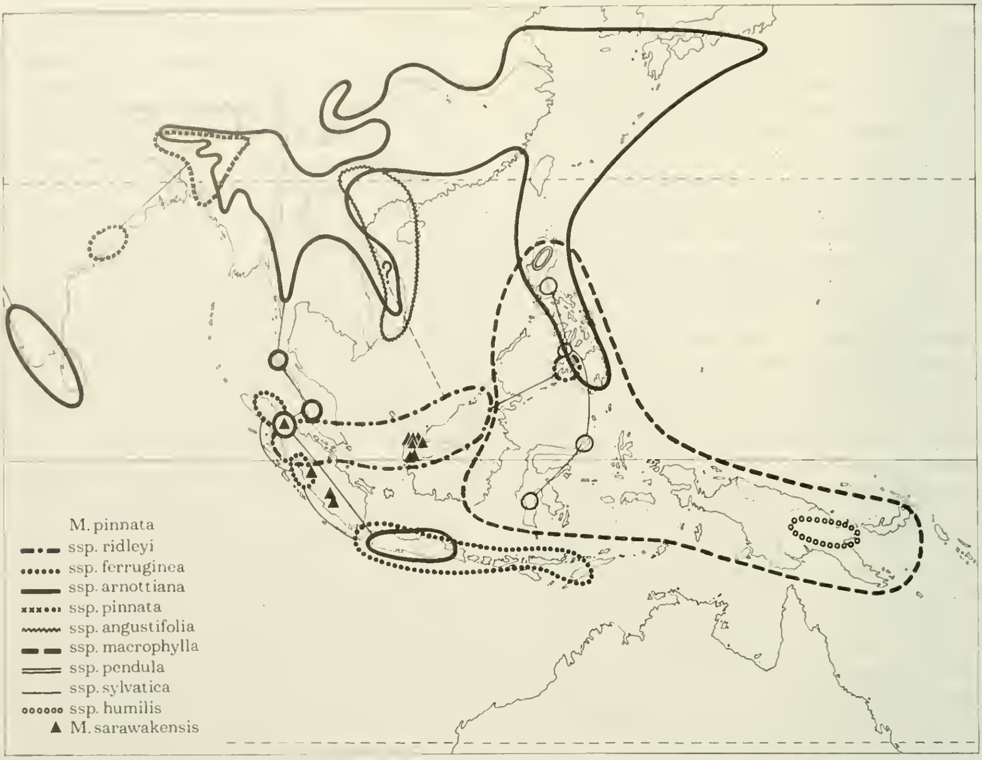

Fig. 13. Generalized areas of the subspecies of *Meliosma pinnata* (ROXB.) WALP., and distribution of *M. sarawakensis* RIDLEY.

subspecies; they centre in W. Malesia. The subspecies of the second group occur scattered at the periphery of the area of *M. pinnata*; I consider them secondary offsplits from the primary subspecies, *viz. ssp. pinnata* and *ssp. angustifolia* (MERR.) BEUS. from *ssp. arnottiana*, and *ssp. pendula, ssp. sylvatica*, and *ssp. humilis* from *ssp. macrophylla*.

The areas of the secondary subspecies fall partly or entirely within the area of the primary subspecies from which they are derived, but they are ecologically isolated from these, usually by preference for different altitudinal zones; transitional or hybrid forms are sometimes found. The areas of the four primary subspecies, on the other hand, all touch or only slightly overlap mutually, but generally they are perfectly replacing, and usually there is also different ecological preference. Due to the scarcity of collections from critical regions, especially Sumatra, Borneo and Sulawesi, it is mostly not clear how the relation is in contact zones. There is some evidence that one or two mutually may behave as good species, where one or two others may be connected by transitional forms, but in general the evidence required is still wanting. In this respect the picture is not so complete as it is in *M. simplicifolia*.

The type subspecies does not occur in Malesia.

KEY TO THE SUBSPECIES

1. Ovary glabrous or only with a few hairs. Sepals and petals always glabrous.
   2. Leaves 3–5-jugate; leaflets dentate (sometimes only a few teeth), with domatia in the axils of the nerves beneath which are sometimes obscured by very dense tomentum of the leaf-blade
   g. *ssp.* **humilis**
   2. Leaves (3–)4–6(–7)-jugate; leaflets dentate or not, without domatia, never with very dense tomentum.
      3. Leaflets entire, index (1–)1.5–3, mostly rounded or obtuse to truncate or emarginate at the base. Medium-sized to large trees
      d. *ssp.* **macrophylla**
      3. Leaflets dentate (sometimes very sparsely), index (1–)1.5–4(–5), acute or rounded, obtuse, truncate or emarginate at the base. Small to medium-sized trees, rarely shrubs.

4. Leaflets moderately to rather densely villous-pubescent (often more or less glabrescent when older), mostly (especially lower ones) rounded to truncate at the base, index 1.5–3(–4). Endocarps 6–7 mm diam., without ventral processus. Above *c.* 1800 m alt. **e.** *ssp.* **pendula**
4. Leaflets sparsely to densely short-pubescent, rarely subglabrous, mostly with acute base, index 1.5–4(–5). Endocarps 5–7.5 mm diam., mostly with a small but distinct ventral processus. Below *c.* 1000 m altitude.
   5. Leaves (3–)4–6(–7)-jugate; leaflets acute at the base .... **f.** *ssp.* **sylvatica**
   5. Leaves 3–5(–6)-jugate; lateral leaflets rounded to truncate at the base **d.** *ssp.* **macrophylla** (Celebes form)

1. Ovary entirely, rarely partly, but always densely pubescent. Sepals and petals glabrous or pubescent.
   6. Sepals and usually also outer petals moderately to densely pubescent on the outside. Leaflets entire, index (1–)1.5–3 .... **c.** *ssp.* **ferruginea**
   6. Sepals and petals glabrous or rarely a few hairs on the outer sepals only. Leaflets entire or dentate, index (1–)1.5–4(–5).
      7. Endocarps 4.5–9(–10) mm diam., usually with more or less sunken ventral pore. Inner petals with fimbriate or ciliolate, rarely glabrous lobes. Leaflets never with domatia **b.** *ssp.* **ridleyi**
      7. Endocarps (2.5–)3–4.5 mm diam., not with sunken ventral pore. Inner petals with usually glabrous, sometimes at the tips ciliolate or frayed lobes. Leaflets with or without domatia **a.** *ssp.* **arnottiana**

a. *ssp.* **arnottiana** (WIGHT) BEUS. Blumea 19 (1971) 499. – *Sapindus ? microcarpus* W. & A. Prod. 1 (1834) 112, *nom. illeg.*, *non* R. & P. (1804); WIGHT, Ill. Ind. Bot. 1 (1840) 142; WALP. Rep. 1 (1842) 416, 423. – *Millingtonia arnottiana* WIGHT, Ill. Ind. Bot. 1 (1840) 144, t. 53. – *Wellingtonia arnottiana* MEISN. Pl. Vasc. Gen. (Comm.) 2 (1840) 207, *in nota.* – *Millingtonia sambucina* JUNGH. Tijd. Nat. Gesch. Phys. 8 (1841) 365. – *Meliosma arnottiana* WALP. Rep. 1 (1842) 423; THW. Enum. Pl. Zeyl. (1858) 59; BEDD. Fl. Sylv. 3 (1871) 77; *ibid.* t. 160; HOOK.*f.* Fl. Brit. India 2 (1876) 6; TRIM. Fl. Ceyl. 1 (1893) 315; BRANDIS, Indian Trees (1906) 195; GAMBLE, Fl. Pres. Madras 1 (1918) 256. – *Meliosma glauca* BLUME, Rumphia 3 (1849) 200, t. 168B, *nom. illeg.*; WALP. Ann. 2 (1852) 225; HASSK. Hort. Bog. 1 (1858) 140; MIQ. Fl. Ind. Bat. 1, 2 (1859) 615; K. & V. Bijdr. 9 (1903) 135, *incl. var. floribunda* (BLUME) K. & V.; HALL.*f.* Meded. Rijksherb. 1 (1910) 2; KOORD. Exk. Fl. Java 2 (1912) 546; Fl. Tjibodas 2 (1923) 157; BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30. – *Meliosma floribunda* BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 615; Illustr. (1871) 74; K. & V. Bijdr. 9 (1903) 137; HALL.*f.* Meded. Rijksherb. 1 (1910) 2; KOORD. Exk. Fl. Java 2 (1912) 546. – *Meliosma sambucina* MIQ. Illustr. (1871) 74; K. & V. Bijdr. 9 (1903) 137, *in obs.* – *Meliosma luzonensis* MERR. Publ. Govt. Lab. Philip. 29 (1905) 24; ELMER, Leafl. Philip. Bot. 2 (1908) 492, *in obs. ('luzonica')*; MERR. Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma multiflora* MERR. Publ. Govt. Lab. Philip. 29 (1905) 25; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Melliosma ferruginea* (*non* BLUME) KOORD. Gedenkb. Jungh. (1910) 177. – *Meliosma apoensis* ELMER, Leafl. Philip. Bot. 10 (1939) 3784, *descr. angl.* – *Meliosma cannarioides* ELMER, Leafl. Philip. Bot. 10 (1939) 3785, *descr. angl.* – *Meliosma ferruginea* (*non* BLUME) BACKER & BAKH.*f.* Fl. Java 2 (1965) 145, *p.p.*, *quoad M. glauca et floribunda.*

Small to medium-sized, rarely big tree, up to *c.* 20(–30) m. *Leaves* (2–)3–7(–8)-jugate; leaflets ovate to ovate-oblong, elliptic, or lanceolate, small to up to *c.* 25 by 10 cm, index (1–)1.5–4(–5), acute to truncate at base, entire or dentate, chartaceous to coriaceous, often with domatia. *Panicles* erect, spreading, lax to dense, lower primary side-axes usually subtended by small or reduced leaves. *Sepals* glabrous or the outer ones rarely with a few hairs. *Petals* glabrous, inner ones sometimes a bit ciliolate or frayed at the tips of the lobes. *Ovary* densely pubescent, very rarely subglabrous. *Endocarps* (sub) globose, not or not much depressed, hardly or not oblique, (2.5–)3–4.5 mm diam., with distinct, more or less prominent, fine reticulum, with slightly to rather strongly prominent, blunt to rather sharp median keel which does not run out into a ventral processus or tubercle; ventral pore not sunken, sometimes a bit elevated.

Distr. Sri Lanka throughout SE. Asia to China, S. Korea, Japan and Taiwan; in *Malesia*: N. Sumatra (Karo), Malay Peninsula, W. & Central Java, Philippines (Batan Is., Luzon, Mindanao). Rare in W. Malesia. Fig. 13.

Ecol. Primary or secondary montane rain-forest, 600–2500 m altitude, on loamy or volcanic soils, also on limestone if the climate is wet enough. At higher altitudes the subspecies is deciduous. In Malesia buttresses are sometimes developed, up to 1.5 m high.

Field notes. Bark dark to light grey, smooth, in old trees sometimes distantly shallowly fissured. Inner bark soft, fibrous, with 'fingers' tapering outwards into granular tissue, pale pinkish brown to dull red or redbrown, also said to be white, and turning salmon red on exposure. Wood light and soft, fibrous, easily split, white, with large pores and beautiful grain, with prominent rays, heartwood in older trees striped reddish and white. Leaflets beneath pale green, often glaucous. *Fruits* said to be reddish, green brown, or black when ripe.

Vern. Sumatra: *kabung sillang bulung*, Batak lang.; Java: *dangdur bulu, kawayang, ki surn, ki tiwu lalaki*, S; Philippines: *adope, adupong, aropong, bantinan, kamug*, Ig., *bae*, If.

Notes. Attention should be given to the relation between *ssp. arnottiana* and *ssp. pendula* in the Philippines (for the relation to *ssp. macrophylla*, see under that subspecies). In the mountains of Luzon both subspecies have been collected, *ssp. pendula* above 1800 m altitude and *ssp. arnottiana* from *c.* 800–900 m up to *c.* 2400 m. Locally, *e.g.* on Mt Santo Thomas, they have been found together, but doubtless intermediate specimens are not observed. It is possible that in such localities these subspecies mutually behave as species; population studies in the field might yield more evidence with regard to this.

The same problem arises in W. Malesia, where *ssp. arnottiana* has been collected (rarely). In Sumatra and in Java its relation to *ssp. ferruginea* is interesting since there is an altitudinal zone of overlap between both, though *ssp. ferruginea* generally occurs lower than *ssp. arnottiana*. In Java the situation is as follows: *ssp. ferruginea* is by far the most common of both, *ssp. arnottiana* having only been collected on a few mountains. Of these it is only G. Salak and G. Gedeh where both subspecies have been found. Only of G. Gedeh more detailed ecological evidence is available: KOORDERS (Fl. Tjibodas 2, 1923, 157) stated that *ssp. ferruginea* occurs at *c.* 1400 m altitude and that *ssp. arnottiana* (*'M. glauca'*) occupies a zone between 1800 and 2400 m, being especially abundant at *c.* 2200 m. This does suggest the existence of ecological differentiation, but since *ssp. arnottiana* on other mountains also grows at lower altitudes, the situation remains unclear.

b. *spp.* **ridleyi** (KING) BEUS. Blumea 19 (1971) 505. — *Meliosma ridleyi* KING, J. As. Soc. Beng. 65, ii (1896) 458; RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 33 (1900) 67; Fl. Mal. Pen. 1 (1922) 516. — *Meliosma elegans* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 54 (1910) 40; Fl. Mal. Pen. 1 (1922) 515. — *Meliosma paucinervia* MERR. Philip. J. Sc. 10 (1915) Bot. 39; Enum. Philip. Fl. Pl. 2 (1923) 518. — *Meliosma trichocarpa* MERR. Pap. Mich. Ac. Sc. 24 (1938) 80, *nom. illeg.*, *non* HAND.-MAZZ. (1934). — *Meliosma bartlettii* MERR. & PERRY, J. Arn. Arb. 20 (1939) 356. — *Meliosma confertiflora* MERR. & PERRY, *l.c.* 359.

Shrub or tree, up to *c.* 20 m. *Leaves* 3–7-jugate; leaflets oblong to lanceolate, small to usually medium-sized, up to *c.* 20 by 6 cm, base acute, rarely rounded, usually entire, densely villous to glabrous, without domatia. *Panicles* erect, usually rather lax and slender; lower primary side-axes mostly subtended by small leaves. *Sepals* and *outer petals* glabrous. *Inner petals* with fimbriate or ciliolate tips, rarely glabrous. *Ovary* densely pubescent. *Endocarps* subglobose to very depressed and oblique, 4.5–9 (–10) mm diam., with vague to distinct, more or less prominent, rather wide reticulum, with slightly to strongly prominent, blunt to very sharp median keel which often at one end runs out into a minute ventral processus, the curving at the other end sometimes far drawn out into a blunt beak; ventral pore hardly to rather deeply sunken.

Distr. *Malesia*: Central Sumatra, Malay Peninsula, Borneo (Sarawak, Sabah, W. Kutai), Philippines (Mindoro). Fig. 13.

Ecol. Primary and secondary rain-forest, both in mixed dipterocarp and in heath forest, on various soil types, from sea-level up to 1400 m altitude.

Field notes. Bark mostly smooth, sometimes somewhat scaly or slightly fissured, grey to brown. Inner bark fibrous, pinkish to red or redbrown, turning brown after exposure. Young branches, inflorescence-axes, and leaf-rachises are sometimes (Singapore) covered with a dense layer of soft dark reddish brown hairs. Sepals sometimes said to be purple. *Fruit* often ± hairy (*'trichocarpa'*), once said to be bright purple.

Vern. Sumatra: *kaju rokkam, k. rube gala, k. si hasur, k. si (mardjuhut) (ni) manuk*, Asahan, *modang halimponan*, Tapanuli.

Notes. *Ssp. ridleyi* is rather variable when compared to the other subspecies of *M. pinnata*, especially in number and dentation of leaflets, in the degree of pubescence, and in shape and size of the endocarps. In the Malay Peninsula, for instance, a form with few subglabrous and somewhat dentate leaflets has been found (*'M. elegans'*), as well as a beautiful, densely rufous-pubescent form with distinctly more and entire leaflets (*'M. ridleyi'*). It is not astonishing that such different plants have been described as separate species; only by studying material from Borneo it becomes clear that these extremes are connected by a range of transitions. Another form from Dallas (Kinabalu), which has rather condensed panicles, has been described as *M. confertiflora*. This again is merely a local form without any systematical significance, as is *M. paucinervia*, with very lax panicles, from Mindanao. Yet, in spite of this variation, it is obvious that *ssp. ridleyi* is a natural unit, probably most closely related to the adjacent *ssp. arnottiana* from which it differs least of all subspecies, mainly in shape and size of the endocarps, but also in some less important characters; an especially close resemblance has been observed between *ssp. ridleyi* and some deviating specimens from South Vietnam which have been tentatively included in *ssp. arnottiana*. Furthermore, the area of *ssp. ridleyi* borders on or somewhat overlaps the areas of *ssp. ferruginea* and *macrophylla*. The relation between *ssp. ridleyi* and these subspecies has been discussed under *ssp. macrophylla*.

Finally, it should be noted that the area of *ssp. ridleyi* fully overlaps that of *M. sarawakensis*; this is not accidental, since the latter probably is a derivative of *ssp. ridleyi* (see the note under *M. sarawakensis*).

c. *ssp.* **ferruginea** (BLUME) BEUS. Blumea 19 (1971) 507. – *Meliosma ferruginea* BLUME, Cat. (1823) 32, *non* SIEB. & ZUCC. *ex* HOOK.*f.* (1876), *nec* KURZ *ex* KING (1896); NEES, Flora 8 (1825) 106; HASSK. Cat. Hort. Bog. (1844) 226; BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 616; Illustr. (1871) 74; K. & V. Bijdr. 9 (1903) 121; KOORD. Exk. Fl. Java 2 (1912) 546; Atlas 2 (1914) t. 375; Fl. Tjibodas 2 (1923) 157; BACKER & BAKH.*f.* Fl. Java 2 (1965) 145, *p.p., excl. M. glauca et floribunda*. – *Millingtonia ferruginea* SCHULT. & SCHULT. Syst. Veg. Mant. 3, add. 2 (1827) 250; DIETR. Syn. Pl. 1 (1839) 103.

Medium-sized to big tree, up to *c.* 42 m. *Leaves* 2–6(–7)-jugate; leaflets elliptic to oblong, basal ones sometimes a bit ovate, upper ones sometimes ± obovate, usually rather large, up to 25(–38) by 10(–18) cm, base rounded to truncate, sometimes acute, entire, firmly coriaceous, pubescent, rarely subglabrous, rarely with domatia. *Panicles* erect, spreading, lax to rather dense; lower primary side-axes usually subtended by small leaves. *Sepals* usually densely pubescent, rarely on the outside sparsely so to subglabrous. *Outer petals* pubescent outside, rarely glabrous. *Inner petals* with fimbriate or ciliolate tips. *Ovary* partly or entirely but almost always distinctly and densely pubescent, very rarely nearly glabrous. *Endocarps* subglobose, often somewhat depressed and oblique, 3.5–5.5(–8) mm diam., with rather vague to distinct, ± prominent reticulum, with usually very prominent, rather sharp median keel which does not run out into a ventral processus or tubercle; ventral pore not or not much sunken.

Distr. *Malesia*: N. & Central Sumatra, throughout Java, and the Lesser Sunda Islands (Bali, Sumbawa, Flores, Timor), locally common, especially in Java. Fig. 13.

Ecol. Rain-forest, preferably on fertile, often volcanic soils, 250–1600 m altitude.

Field notes. Bole cylindrical, straight, sometimes crooked, at the base up to *c.* 2.5 m diam. Bark on the surface grey to brown, smooth, sometimes a bit peeling or shallowly fissured to (deeply) cracked, about 0.7–1.5 cm thick, easily detachable. Inner bark pale brown to brownred or orange, with streaks, also said to be dirty white and turning orange brown when exposed to the air as a result of the discolouring of the initially colourless watery exudation. Wood soft, yellowish to pinkish white. Leaflets pale greyish to glaucous green beneath. Fruits brownred to black when ripe.

Uses. Advocated for reafforestation purposes by KOORDERS.

Vern. Sumatra: *sekapong*, Takengon, *sontang*, Simelungun, *sihubung*, Kerinci; Java: *ki tiwu, ki tjermè badak*, S, *gempong, gijubuk, gompong*, J; Lesser Sunda Is.: *gempong, sambuk*, Bali, *mladja, tanggo, tawu*, Flores, Endeh lang., *lohot, raok*, Flores, *kaju mangkok*, W. Sumbawa.

Note. *Ssp. ferruginea* is usually well recognizable by its outside pubescent sepals and petals. However, in N. Sumatra and the Lesser Sunda Islands specimens occur in which these characters are imperfectly or not developed, and they may also lack the pubescence on the ovary and may have almost glabrous leaves. They are not easily identifiable and may be confused with *M. lanceolata var. lanceolata f. nervosa* or with the closely related *M. pinnata ssp. macrophylla* and *ssp. ridleyi*.

d. *ssp.* **macrophylla** (MERR.) BEUS. Blumea 19 (1971) 510. – *Meliosma macrophylla* MERR. Philip. J. Sc. 7 (1912) Bot. 294; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma lanceolata var. obliqua* (*non* BLUME) KOORD. Minah. (1898) 408; Suppl. 2 (1922) 7, t. 55; *ibid.* 3 (1922) 28. – *Meliosma wallichii* (*non* PLANCH. *ex* HOOK.*f.*) KOORD. Minah. (1898) 408. – *Meliosma tongcalingii* ELMER, Leafl. Philip. Bot. 8 (1915) 2815. – *Meliosma megalobotrys* MERR. Philip. J. Sc. 11 (1916) Bot. 16; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma macrocarpa* ELMER, Leafl. Philip. Bot. 10 (1939) 3786, *descr. angl.* – *Meliosma ferruginea* (*non* BLUME) MERR. & PERRY, J. Arn. Arb. 20 (1939) 356. – **Fig. 12.**

Medium-sized to large tree, up to *c.* 42 m. *Leaves* (3–)5–9-jugate; leaflets elliptic to oblong to ovate-oblong, medium-sized to rather large, up to *c.* 20 by 9 cm, base rounded or obtuse to truncate, entire, rarely with a few teeth (Sulawesi), chartaceous to firmly coriaceous, very sparsely to densely pubescent, always without domatia. *Panicles* erect and spreading, lax and slender to rather dense; lower primary side-axes usually subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous, rarely with a few scattered hairs. *Endocarps* subglobose, sometimes more obovoid or depressed, more or less oblique, 3.5–5 mm diam., exceptionally 5–7.5 mm diam. (Sulawesi), with vague to distinct and prominent reticulum, with rather sharp and prominent median keel which at one end mostly runs out into a small but distinct ventral processus or tubercle; ventral pore somewhat sunken.

Distr. *Malesia*: E. Borneo (E. Sandakan, Berao, W. & E. Kutai, Tandjung), Sulawesi (Minahasa, Malili), Moluccas (Halmahera, Seram), Philippines (Luzon, Leyte, Mindanao, Palawan), throughout

New Guinea (incl. New Britain). Fairly common in most parts of the area. Fig. 13.

Ecol. Usually in primary, rarely in secondary rain-forest, at low to medium altitudes; in Borneo only collected below 100 m, in the other parts of the area also higher, up to *c.* 1100–1200 m, in W. New Guinea once at 1800 m. In Borneo usually found in lowland dipterocarp forests. Generally reported to occur on clayish, loamy, or sandy clayish soils, also on red earth, on volcanic soil, and on loamsoil on limestone. It is rarely found in occasionally submerged areas. Once (New Guinea) said to occur on peaty soil, and there developing stiltroots.

Field notes. Bole mostly straight, cylindrical, up to at least 1 m diam. at the base, usually developing 1.5–2.5 m high buttresses, sometimes without buttresses, once observed stiltrooted. Bark grey to brown, or patchy brown-white-grey, smooth, sometimes with shallow vertical cracks, not or little peeling, with vertical rows of lenticels. Inner bark *c.* 1 cm thick, soft, light brown or pink to brownred, inside paler, sometimes said to be streaked with cream, with some colourless sticky exudate (which is also said to be redbrown!); it is said to be rapidly darkening upon exposure or 'a bright orange-brown stain quickly appears between bark and sapwood.' Wood very light and soft; sapwood white to pale pink or brown, when fresh with bright brown sap streaks, heartwood absent or present, darker than the sapwood. The fruit is said to be brown to black.

Vern. Borneo: *surian*, E. Kutai; Sulawesi: *kaju-saut-rintek*, Tooelooe lang., *papako*, Tontemboan lang., *mumping*, Tonsea lang., *liasan*, Ratahan lang.; Moluccas: *bais*, Seram; Philippines: *arocong*, Ig., *agosos, balilang-uak* (a corruption of *barilan ng uak*), Tag., *morau*, S.L.Bis., *muñgapong*, Bik., *magasorod*, Bag.; New Guinea: *sebotebuk, tubuk*, Mooi, *serajema*, Manikiong, *marwaskeipi*, Japen, *bagare*, Kapauku lang., *biedewon, iediewat*, Muju, *morrotuno, waito*, Wapi, *frikipa*, Orne lang., *tapuha*, Managalase, *kufi*, Kutubu, *uliga*, Madang, *kombowase*, Waskuk, *wagebi*, Wagu.

Notes. *Ssp. macrophylla* is the most common and widespread of the East Malesian subspecies group, characterized by a glabrous ovary by which it is readily distinguished from the West Malesian subspecies. Within its large area a few other subspecies occur, *viz. ssp. pendula, sylvatica*, and *humilis*, which have much more limited areas and probably represent offsplits from it. These three subspecies are ecologically well isolated from *ssp. macrophylla.*

In Borneo the area of *ssp. macrophylla* is, as far as can be judged from the available evidence, sharply delimited against that of the West Malesian *ssp. ridleyi*, which, moreover, appears to prefer a higher altitudinal zone (only in Borneo *ssp. macrophylla* seems to be restricted to lowland forests below *c.* 100 m altitude!). To the SW the area of *ssp. macrophylla* borders on that of *ssp. ferruginea* which inhabits the Lesser Sunda Islands. The latter two subspecies are huge trees, very similar in general habit, and sometimes they have been confused. Nevertheless, they are usually well distinct, mainly by flower characters, though in both subspecies there is a tendency to lose some of these characters.

In the Philippines *ssp. macrophylla* is sympatric with *ssp. arnottiana*, but they prefer different altitudinal zones, the first being a lowland subspecies not exceeding *c.* 900 m altitude, the latter being a montane subspecies occurring from *c.* 800 up to *c.* 2400 m (once recorded from *c.* 600 m).

e. *spp.* **pendula** (MERR.) BEUS. Blumea 19 (1971) 512. – *Meliosma pendula* MERR. Publ. Govt. Lab. Philip. 29 (1905) 25; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma reticulata* MERR. Philip. J. Sc. 5 (1910) Bot. 195; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma macgregorii* MERR. Philip. J. Sc. 10 (1915) Bot. 37; Enum. Philip. Fl. Pl. 2 (1923) 517.

Small to medium-sized tree, up to *c.* 20 m. *Leaves* (3–)4–6-jugate; leaflets elliptic to oblong, rarely lanceolate, up to 18(–20) by 7(–11) cm, the lower ones at the base nearly always rounded or (sub)truncate to obtuse, the upper ones more or less acute, nearly always distinctly dentate, villous-pubescent, ± glabrescent, without domatia. *Panicles* erect and spreading to somewhat pendulous and rather flaccid, slender and rather lax; lower primary side-axes mostly subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous. *Endocarps* subglobose, slightly oblique, 6–7 mm diam., with rather vague, slightly elevated reticulum, with hardly to moderately prominent, blunt median keel, the latter not running out into a distinct ventral processus or at most into a very minute tubercle; ventral pore hardly or not sunken.

Distr. *Malesia*: Philippines (Luzon: Mountain Prov.). Fig. 13.

Ecol. Montane rain-forest, 1800–2500 m altitude. In mossy forest, in ravines as well as on exposed ridges.

Field notes. Bark thick, checked. Wood soft, said to be soon assuming an orange-brown colour.

Uses. The leaves are once said to be used for smoking by the Igorots.

Vern. *Anitap*, Ig.

Note. *Ssp. pendula* replaces the lowland and lower hill *ssp. macrophylla* at high elevations (in this respect being comparable to *ssp. humilis* from New Guinea).

f. *ssp.* **sylvatica** (ELMER) BEUS. Blumea 19 (1971) 513. – *Meliosma sylvatica* ELMER, Leafl. Philip. Bot.

2 (1908) 492; MERR. Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma acuminatissima* MERR. Philip. J. Sc. 10 (1915) Bot. 36; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma brachybotrys* MERR. Philip. J. Sc. 12 (1917) Bot. 275; Enum. Philip. Fl. Pl. 2 (1923) 517.

Slender shrub or treelet, up to *c.* 5 m. *Leaves* (3–)4–6(–7)-jugate; leaflets elliptic to usually oblong or lanceolate, usually medium-sized, up to *c.* 18 by 6 cm, acute at the base, sparsely to rather closely, always distinctly dentate, very sparsely to moderately pubescent, without domatia. *Panicles* erect, spreading, usually slender and rather lax; primary side-axes (mostly?) not subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous. *Endocarp* subglobose, often somewhat ellipsoid, more or less oblique, 5–6 mm diam., with distinct, more or less prominent reticulum, with rather sharp and prominent median keel which at one end runs out into a small but distinct ventral processus; ventral pore somewhat sunken.

Distr. *Malesia*: Sulawesi (Minahasa, Latimodjong Mts), Philippines (Luzon, Negros). Fig. 13.

Ecol. Lowland rain-forest, usually not above 750 m altitude, growing in the shrub layer.

Field notes. Slender, suberect or bent shrub or treelet of a sparsely branched habit. Bark smooth, grey and brown mottled. Wood white, soft, easily breakable. Leaves once said to be light bluish green beneath.

Note. *Ssp. sylvatica* is closely related to *ssp. macrophylla*. The most striking difference between them is found in their physiognomy, the former being a small undergrowth treelet, the latter a large forest tree. The main systematical differences are found in the dentation and the shape of the base of the leaflets. These fit nicely in the spectre of character combinations present in the subspecies of *M. pinnata*, and it seems justified to consider *ssp. sylvatica* a subspecies of that species, instead of a separate species.

g. *spp.* **humilis** (MERR. & PERRY) BEUS. Blumea 19 (1971) 514. – *Meliosma humilis* MERR. & PERRY, J. Arn. Arb. 20 (1939) 358; *ibid.* 22 (1941) 263, *in obs.* – *Meliosma schlechteri* MERR. & PERRY, J. Arn. Arb. 22 (1941) 262.

Small to medium-sized tree, up to *c.* 20 m. *Leaves* 3–5 jugate; leaflets elliptic to oblong, rarely short-lanceolate, usually rather small, up to *c.* 15(–24) by 6(–9) cm, the base acute, lower leaflets sometimes rounded at the base, sparsely to rather closely dentate, beneath subglabrous to rather densely pubescent, sometimes densely villous-tomentose, always with more or less distinct domatia in the axils of the nerves beneath (obscure in densely tomentose leaflets). *Panicles* erect, spreading, mostly rather lax and with slender axes; lower primary side-axes often subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous. *Endocarps* subglobose, somewhat depressed and rather oblique, 5.5–7.5 mm diam., with more or less vague, slightly elevated reticulum, with very prominent, rather sharp median keel which at one end runs out into a small but distinct ventral processus; ventral pore somewhat sunken.

Distr. *Malesia*: Papua New Guinea (Highlands Provinces, Madang, Morobe, Milne Bay). Common. Fig. 13.

Ecol. Montane rain-forests, 1000–3000 m altitude. Observed as an understorey tree in dense *Castanopsis-Nothofagus* forest, on ridges as well as on streambanks, but also often reported from several kinds of disturbed forest, such as bamboo regrowth, old garden land, transition between coniferous forest and treefern grassland, and even from open grassland. Once reported from limestone ridge.

Field notes. Bark greybrown, smooth, with big lenticels. Inner bark straw-coloured to pink, red, or reddish brown (due to discolouring, as in other subspecies?), exuding 'resin'. Wood white to light brown, with conspicuous rays and clear growth rings, said to be of moderate weight and hardness. Petioles, peduncle, and pedicels purplish to red-brown; buds reddish. *Fruits* dark red to black when ripe.

Uses. Once said to be used as housing timber, free from borers.

Vern. *Mansalong*, Finschhafen, *kokopong*, Nako lang., E. Madang Prov., *kass*, Maring lang., *mappam*, Enga lang., W. Highl. Prov.

Notes. *Ssp. humilis* is closely allied to *ssp. macrophylla*, mainly differing by its dentate leaflets with domatia. In Papua New Guinea it replaces *ssp. macrophylla* mainly found below 1000 m altitude (*cf. ssp. pendula* from Luzon). It is remarkable that *ssp. humilis* has as yet been collected, even rather abundantly, only in Papua New Guinea and not in W. New Guinea.

7. **Meliosma sarawakensis** RIDLEY, Kew Bull. (1933) 193; MERR. & PERRY, J. Arn. Arb. 20 (1939) 359. – *Meliosma grandifolia* LECOMTE, Bull. Soc. Bot. Fr. 54 (1909) 676, *nom. illeg.*, *non* URBAN (1895); MERR. Enum. Born. (1921) 362; VAN BEUSEKOM, Blumea 19 (1971) 515. – *Meliosma confusa var. laxior* BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30. – *Meliosma latifolia* RIDLEY, Kew Bull. (1933) 193; MERR. & PERRY, J. Arn. Arb. 20 (1939) 359, *in obs.*

Evergreen, small tree, up to *c.* 10 m. *Leaves* 2–3(–4)-jugate; rachis terete, 12–30 cm, including the 6–15 cm long petiole, up to *c.* 5 mm diam., densely short-tomentose, later ± glabrescent; leaflets usually elliptic to oblong, the lower ones often more or less ovate to ovate-oblong, the upper ones often more or less obovate to obovate-oblong, sometimes ± asymmetrical, (2–)5–22 by (1.5–) 3–12 cm, mostly distinctly increasing in size towards the top of the leaf, base acute to rounded, apex more or less acuminate, sometimes subacute or cuspidate, with entire to remotely spinously dentate margin, chartaceous, moderately to rather densely pubescent especially beneath and on midrib and nerves, often partly glabrescent when older, never with domatia; midrib more or less impressed above; nerves 6–12 pairs, ascending, usually looped; venation distinct, reticulate; petiolules up to *c.* 1.5(–3) cm, terminal one usually longest, tomentose. *Panicles* terminal, usually more or less pendulous, flaccid, lax, narrowly pyramidal, (20–)25–55 cm, not profusely branched up to the 2nd or 3rd order, branches spreading, ± flaccid, usually slender, densely tomentose, bearing numerous flowers crowded in dense spikes; primary side-axes few to rather many, up to *c.* 25(–35) cm, the lower ones usually subtended by reduced leaves; bracts ovate to usually narrowly triangular or linear-lanceolate, up to *c.* 4 mm, densely pubescent. *Pedicels* (almost) absent. *Mature buds c.* 2 mm diam. *Sepals* 5 (4), ovate to ovate-lanceolate, the 3 or 4 inner ones 1–1.5 mm, the outer 1 or 2 usually much smaller, often minute, densely pubescent on the outside, with entire margin. *Outer petals* glabrous. *Inner petals* about halfway or somewhat less bifid, 0.5–0.7 mm, glabrous, sometimes with a minute central lobule. *Filaments c.* 1 mm. *Ovary* 0.5–0.7 mm, densely pubescent. *Fruit* (sub)globose, when ripe 0.7–1 cm diam.; *endocarp* depressed-globose, applanate at the ventral side, strongly oblique, 6–7(–8) mm diam., with usually distinct, more or less sharply prominent reticulum; median keel sharp and very prominent, not at one end running out into a ventral processus or tubercle, at the other end rather far curving outwards; ventral pore rather sunken.

Distr. *Malesia*: Sumatra (Asahan to Palembang) and NW. Borneo (Sarawak, around Kuching and Pontianak; common). Fig. 13.

Ecol. Lowland rain-forest, up to *c.* 800 m altitude.

Field notes. The sepals are redbrown to purple.

Vern. Sumatra: *kaju rube boras*, Asahan; Borneo: *bulu manok*, Iban name, Kuching.

Note. The closest affinity of *M. sarawakensis* is doubtless with *M. pinnata ssp. ridleyi* to which it is very similar in all characters (they even share the red sepals). Only after some hesitation *M. sarawakensis* is maintained as a separate species and not made a subspecies of *M. pinnata*. It would fit rather well into that species but is distinguished from it by a wider range of characters. The most important of its characters are the 2- or 3-jugate leaves and the densely pubescent sepals. These characters indeed are also found in *M. pinnata ssp. ferruginea*, but this subspecies is quite different from *M. sarawakensis* in various other aspects. An additional argument to the specific status of *M. sarawakensis* is found in the fact that it is found together with *M. pinnata ssp. ridleyi* in the same area and at the same altitudes in Sarawak (near Kuching) and in Sumatra (Asahan), without any sign of hybridization.

8. **Meliosma rufo-pilosa** HEND. Gard. Bull. Str. Settl. 7 (1933) 96, t. 18; MERR. & PERRY, J. Arn. Arb. 20 (1939) 360; VAN BEUSEKOM, Blumea 19 (1971) 517.

Evergreen rather large tree up to *c.* 30 m. *Flowering twigs* terete, 5–10 mm diam., stout, abruptly terminating in a tuft of leaves and inflorescences, glabrous, often with many large conspicuous leaf-scars. *Leaves* (6–)7–9-jugate; rachis terete, (13–)25–50 (–65) cm, including the (3.5–)6–16 cm long petiole, pubescent, not swollen at the base, hardly or not lenticellate; leaflets elliptic to oblong, sometimes ovate (-oblong), 3–15 by 2–6 cm, base obtuse to truncate, apex acuminate, entire, glabrous or ± puberulous on nerves above, (sub)glabrous beneath, pubescent on nerves, always without domatia; midrib impressed above; nerves 7–18 pairs, ascending, looped; venation fine, very distinct, reticulate; petiolules 1–6 mm, densely pubescent. *Panicles* terminal, one or a few crowded together at the end of a twig, erect, rather dense to lax, pyramidal, 30–50 cm, including the 0–20 cm long peduncle, profusely branched up to the 4th order, branches spreading, ± flaccid, densely pubescent, bearing numerous solitary flowers; primary side-axes well-spaced, *c.* 8–15, up to *c.* 30 cm, not lenticellate, the lower ones never subtended by small or reduced leaves; bracts narrowly triangular to lanceolate, up to *c.* 4 mm, densely pubescent. *Pedicels* 1–3 mm, densely pubescent. *Sepals* (3) 4, ovate, (sub)equal, *c.* 1.5–2 mm, the outer one often much smaller, rarely minute, usually lowered on the pedicel, glabrous or somewhat pubescent outside; margin flimsy, more or less ciliolate, entire or sometimes with some coarse irregular teeth. *Outer petals c.* 1.5 by 1.5–2.5 mm. *Inner petals* ligular, usually somewhat widened towards the top, 0.7–1 mm; top entire or with a shallow incision, blunt, minutely ciliolate. *Filaments* 0.7–1 mm. *Ovary* 0.5–0.7 mm, glabrous. *Fruit* globose, when ripe 1.5–2 cm diam., with moderately thick, fleshy mesocarp; endocarp semiglobose, broad-ovate to subcordate at ventral view, 11–13 mm long and wide, 7–8 mm high, with relatively thin wall, with slightly lumpy surface, especially lumpy and somewhat furrowed at the ventral curving of the wall; median keel faint, hardly elevated but at one end drawn out into a conspicuous, laterally flattened, downwards-curved, blunt beak; ventral side rather deeply concave with a smooth, wide-ovate to suborbicular central part from the centre of which protrudes the ± conical hilum of the seed.

Distr. *Malesia*: Malay Peninsula (Pahang), Borneo (Sarawak, Sabah, Kinabalu complex). Fig. 11.

Ecol. Montane rain-forest, 1350–1700 m altitude.

Field notes. Large tree with deep, rounded crown, once reported with *c.* 2 m high buttresses. Bark smooth, grey to brown, with lenticels in vertical rows ('scarred', 'dippled'). Inner bark soft, fibrous, orange to reddish outside, pale fawn to white towards the cambium. Sapwood pale brown. Twigs pale brown, rough, lenticellate, with darker leaf-scars. Leaves pale green. Fruit yellow to orange when ripe.

Vern. Malay Peninsula: *sengkuang*, Genting Highlands.

Excluded and dubious

Meliosma celebica WARB. *ex* DIHM, Beih. Bot. Centralbl. 21, 1 (1907) 125, *nomen*. – I have not seen the type specimen (WARBURG 15416, Sulawesi, Bojong), which probably got lost during World War II.

Meliosma laurina BLUME, Rumphia 3 (1849) 198; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Illustr. (1871) 73; MERR. Enum. Born. (1921) 363; HALL.*f.* Beih. Bot. Centralbl. 39, 2 (1921) 161; KOSTERM. Bibl. Laur. 1 (1964) 951. – As was noted by HALLIER *f.*, *l.c.*, the type specimens (S. MÜLLER *s.n.*, Borneo, G. Sakumbang) consist of a mixture, *viz.* inflorescences of *M. sumatrana* and leaves of *Cryptocarya reticulata* BLUME (*Lauraceae*).

Meliosma petiolaris MIQ. Sum. (1861) 519, 203; Illustr. (1871) 73, *in obs.* – This species was later referred by MIQUEL himself to *Xylosma leprosipes* CLOS which is now known as *Bennettiodendron leprosipes* (CLOS) MERR. (*Flacourtiaceae*).

Meliosma timorensis BLUME *ex* BLENK, Flora 67 (1884) 370, *nomen*. – This name was cited in an enumeration of *Meliosma* species having leaves with pellucid dots; it was probably copied from a label on a sheet. The specimen could not be traced.

Pimela angustifolia BLUME, Mus. Bot. Lugd.-Bat. 1 (1850) 226. – *Canariopsis angustifolia* BLUME *ex* MIQ. Fl. Ind. Bat. 1, 2 (1859) 653. – *Canarium angustifolium* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 117; H.J.LAM, Bull. Jard. Bot. Btzg III, 12 (1932) 179, t. 11 f. 71d, *sub C. rigidum* ZIPP.; LEENH. Fl. Males. I, 5 (1956) 296.

The material under this name was excluded from the *Burseraceae* by LEENHOUTS, *l.c.*, and tentatively assigned to MELIOSMA. This may be correct, and it should then be placed close to *M. lanceolata* and *M. hirsuta*. At first sight it is very similar to the latter species, but there are important differences in nervation and pubescence. If it belongs to *Meliosma* it would certainly be a new species, but I refrain from including it because I am not sure about its identity. Unfortunately, the specimens consist of young leaves only, with many characteristic narrow leaflets, but in absence of woody parts it cannot be identified with certainty. Moreover, on the original labels (ZIPPEL *s.n.*) the place of origin is mentioned as being 'Nova Guinea', in BLUME's handwriting. However, this would not fit in the distribution pattern of *Meliosma*, since species of this kind only occur in western Malesia; if New Guinea indeed is the correct locality, *'Canarium angustifolium'* can hardly belong to *Meliosma*. Its identity will probably remain uncertain until more satisfactory material has been found.

ADDENDA, CORRIGENDA ET EMENDANDA

C.G.G.J. van Steenis†, W.J.J.O. de Wilde, *c.s.*

As was done in the preceding volumes, it seemed useful to correct some errors which have crept into the text of volumes 4–10 as well as to add some additional data, new records and references to new species which came to our knowledge and are worth recording.

Volume and page number are separated by a colon. Page numbers provided with either *a* or *b* denote the left and right columns of a page respectively.

Araliaceae

9: 47b *Osmoxylon sessiliflorum* (Laut.) Philipson.
Add to Distr.: Moluccas (Halmaheira), 2 coll.
Add to Vern.: *saha-saha*, Ternate lang., *tele*, Sahu lang.

Bignoniaceae

8: 142b *Dolichandrone spathacea* (L. *f.*) K. Sch.
Add to Distr.: A.G. Wells, in H.J. Teas (ed.), Biology and ecology of mangroves (1983) 61, map, records this species for the first time from Australia: the northern tip of Cape York Peninsula (2 localities).

Cardiopteridaceae

7: 93 *Cardiopteris* [Wall. *ex*] Royle.
Add to Distr.: The genus extends to the Solomon Islands (Bougainville) and N. Queensland; *cf.* Bailey, Queensl. Fl. (1899) 251; Compreh. Cat. Queensl. Pl. (1912) 93, f. 76.

Celastraceae

6: 257b *Glyptopetalum loheri* Merr.
Distr.: Philippines: add Palawan (Ridsdale 683).

6: 266a *Lophopetalum beccarianum* Pierre.
Add to Distr.: Central Sumatra (Djambi: Vreeken-Buys 69).

6: 291b *Perrottetia alpestris* (Bl.) Loes. *ssp. philippinensis* (Vidal) Ding Hou.
Add to Distr. (and map): Lesser Sunda Islands (Flores: Loeters 650, 1796).

Convolvulaceae

4: 434b *Jacquemontia browniana* Ooststr.
Add the synonym: *J. pannosa* (R. Br.) Mabberley, Bot. Macar. 6 (1980, '1978') 63.

Cyperaceae

7: 653a *Cyperus diaphanus* Schrader *ex* R. & S. *var. latespicatus* (Boeck.) Kern.
Add to Distr.: Lesser Sunda Islands (Flores: Schmutz 5767).

9: 173a *Carex bilateralis* Hayata.
Add to Distr.: SE. to E. Asia.

Dipterocarpaceae

9: 436b *Hopea gracilis* Miq. (under Excluded). It was unfortunately overlooked that the type at L (W. Central Sumatra, Padang, Teijsmann HB 424) was already in 1968 referred by Ashton to *Meiogyne* and later in the same year identified by F.H. Hildebrand as *Meiogyne virgata* (Bl.) Miq. (*Annonaceae*).

Ericaceae

6: 856b *Vaccinium angulatum* J.J.S. 1914, *non* (Griff.) Theobald, 1883 = **Vaccinium commutatum** Mabberley & Sleumer, Taxon 34 (1985) 155, *nom. nov.*

Flacourtiaceae

5: 24b *Hydnocarpus nana* King.
Add to Distr.: NE. Sumatra (Besitang R., Sikundur For. Res., de Wilde & de Wilde-Duyfjes 19540).

5: 35a *Scaphocalyx spathacea* Ridl.
Add the synonym: *S. parviflora* Ridl. *etc.*

5: 35b Reduce *Scaphocalyx parviflora* Ridl. to *S. spathacea* Ridl.

5: 56a *Homalium dasyanthum.*
Change authorship: (Turcz.) Theob. in Mason, Burma ed. Theob. 2 (1883) 451; Warb. *etc.* (see Mabberley, Taxon 34, 1985, 155).

5: 98b Reduce *Casearia pallida* Craib. to *C. flavovirens* Bl.

5: 100b *Casearia flavovirens* Bl.
Add the synonym: *C. pallida* Craib, *etc.*

Add to Distr.: Thailand; in Malesia: Sumatra, Java, Lesser Sunda Islands (Bali).

Haemodoraceae

5: 113a *Haemodorum corymbosum* VAHL should be called **Haemodorum coccineum** R.BR., according to T.D. MACFARLANE, Perth, Australia.

Hamamelidaceae

5: 366 *Maingaya malayana* OLIVER.
A marvellous colour photograph of this very rare species (and genus), endemic in Malaya and Penang, was given by FRANCIS NG in Nature Malaysiana 7, no 4 (1982) 8; the species is thought to be ± extinct and is now grown at the Forest Research Institute, Kepong.

Hydrocharitaceae

5: 390b, *Blyxa aubertii* RICH.
391 Add: *var.* **echinosperma** (CLARKE) COOK & LÜÖND, Aquat. Bot. 15 (1983) 14.
Add the synonym: *B. echinosperma* (CLARKE) HOOK.*f. etc.*

5: 392a *Blyxa leiosperma* KOIDZ.
Reduced to *B. japonica* (MIQ.) MAXIM. *ex* ASCHERS. & GÜRKE *var. japonica*.

5: 392b *Blyxa alternifolia* (MIQ.) HARTOG.
Reduced to *B. japonica* (MIQ.) MAXIM. *ex* ASCHERS. & GÜRKE *var. alternifolia* (MIQ.) COOK & LÜÖND, Aquat. Bot. 15 (1983) 25.

5: 393a *Blyxa japonica* (MIQ.) MAXIM. *ex* ASCHERS. & GÜRKE.
Add: *var.* **japonica** and *var.* **alternifolia** (MIQ.) COOK. & LÜÖND, Aquat. Bot. 15 (1983) 22 and 25 respectively.
Add the synonyms: *B. leiosperma* KOIDZ. and *B. alternifolia* (MIQ.) HARTOG.

Hypericaceae

8: 18b Replace *Hypericum uralum* BUCH.-HAM. *ex* D.DON by **Hypericum henryi** LÉV. & VANIOT *ssp.* **hancockii** ROBSON, Bull. Br. Mus. Nat. Hist. Bot. 12 (1985) 261, map 22. Distr. of var.: Continental SE. Asia (S. China, Vietnam, Burma, Thailand).

Icacinaceae

7: 6a *Citronella suaveolens* (BL.) HOWARD.
Add to Distr.: Lesser Sunda Islands (Flores: SCHMUTZ 5819).

Iridaceae

8: 83 The correct name for *Gladiolus natalensis* (ECKLON) REINW. *ex* HOOK. should be **Gladiolus dalenii** GEEL, Sert. Bot. fasc. 28 (1829). See HILLIARD & BURTT, Notes Roy. Bot. Gard. Edinb. 37 (1979) 297.

Olacaceae

10: 7a The correct name for *Olax scandens* ROXB. should be **Olax psittacorum** (WILLD.) VAHL; see ALMEIDA, J. Bomb. Nat. Hist. Soc. 81 (1985) 742.

10: 9b Excluded, add:
Olax baticulin BLANCO, Fl. Filip. ed. 2 (1854) 589; ed. 3 (1877) 38; KOSTERM. Bibl. Laur. (1964) 1153 = *Litsea baticulin* (BLANCO) KOSTERM. Bull. Bot. Surv. India 10 (1968) 268 (*Lauraceae*).
MERRILL (Enum. Philip. Fl. Pl. 2, 1923, 195) recognized it as a *Litsea* and said that it might prove to belong to *L. leytensis* MERR. Since no material is known to exist, the matter will remain speculative.

Passifloraceae

7: 416a *Passiflora aurantia* FORST. *f.*
Add to Distr.: W. Central Celebes, near Palu, at 200 m, MEIJER 10172.

Pittosporaceae

5: 356b *Pittosporum moluccanum* (LAMK) MIQ.
Add the synonym: *Coffea angustifolia* ROXB.; *cf.* FORMAN, Kew Bull. 38 (1983) 64.

Podostemaceae

6: 66b *Cladopus nymani* H. MÖLL.
Add to Distr.: Central Borneo, en route from Sinar Baru to Ryan Ruwan, N of Long Bawan, Krayan, 115° 45′ E, 4° 5′ N, on rock in a rapid stream (Pa Raya), submerged and sterile, 1150 m alt., M. OKAMOTO *c.s.*, *s.n.* (L, Osaka). The material matches the figure on p. 66 of Fl. Males. 1, 4 almost exactly.

Rhizophoraceae

5: 461b *Bruguiera gymnorrhiza* (L.) SAVIGNY.
Distr.: It is worthy of record that according to an internal report by A.N. GILLISON (CSIRO, Canberra) this mangrove species is found on the lower limestone terrace on

Christmas I. (Indian Ocean), in a healthy and self-maintaining community near the freshwater Hosnie's Springs at 40 m alt., and not far from it a stand of a remnant littoral forest of *Heritiera littoralis* DRYAND. in AIT., another mangrove species.

5: 471a *Ceriops decandra.*
The authorship must be (GRIFF.) THEOBALD; see Taxon 34 (1985) 154.

Simaroubaceae

6: 218b *Ailanthus integrifolia* LAMK.
Add to Distr. (and map): N. Queensland (several localities) (L. PEDLEY, in litt.).

Sparganiaceae

4: 233 The correct name for *Sparganium simplex* HUDS. *f. simplex* as used by BACKER should be:
Sparganium fallax GRAEBN. in E. & P. Pfl. R. 2 (1900) 15, t. 3H; COOK & NICHOLLS, Bot. Helv. 96 (1986) 253; *ibid.* 97 (1987) 3, t. 13a, 14a, map 14. – *S. simplex auct. non* HUDS. *f. simplex*: BACKER, Fl. Males. I, 4 (1951) 233, fig.

Basal leaves usually exceeding the stem, (4–)5–10(–15) mm wide. Lowermost bract 20–35(–60) cm long, 1–several times as long as the inflorescence. Female heads 3–4(–6), usually supra-axillary, sometimes extending beyond the next internode; peduncle up to 3 cm long. Male heads 5–8 or more. Female flowers: perianth segments at least connate below, in fruit more than 0.5 times as long as the fruit; pedicel 1–3 mm long. Male flowers: filaments up to 6 or more mm long; anthers (0.8–)1–2(–2.2) mm long. *Fruits* fusiform, sometimes constricted around the middle, 5–6 mm long, light brown, dull, tapering below into a 1.5–3 mm long pedicel. Endocarp *c.* 2 mm wide.

Distr. E. India to Japan; in *Malesia*: Sumatra, Papua New Guinea (up to 2000 m alt.).

Sparganium subglobosum MORONG, Bull. Torrey Bot. Club 15 (1888) 81, t. 79, f. 1; COOK & NICHOLLS, Bot. Helv. 97 (1987) 4, t. 13b, 14b, map 15.

Basal leaves usually exceeding the inflorescence, (1–)2–4(–9) mm wide. Lowermost bract up to 15 cm long, 0.5–1 (rarely more) times as long as the inflorescence. Female heads solitary, axillary or on lateral branches, occasionally one head supra-axillary, sessile, rarely with an up to 5 mm long peduncle. Male heads solitary. Female flowers: perianth segments free, in fruit 0.3–0.5 times as long as the fruit; pedicel 0–1 mm long. Male flowers: filaments 2.5–3.2(–3.8) mm long, anthers 0.5–0.9 (–1) mm long. *Fruits* obovoid to almost globose, yellowish to pale brown, shiny, subsessile or with an up to 1 mm long, not persistent pedicel. Endocarp 1.6–1.8 mm wide.

Distr. India (once, in Khasia), Yunnan, Vietnam to Manchuria and to Okinawa, Australia, New Zealand; in *Malesia*: Papua New Guinea.

Note. The identity of a collection from Arfak is not resolved by COOK & NICHOLLS.

Symplocaceae

8: 217 *Symplocos* JACQ. *subg. Hopea* CLARKE.
Add in key couplet 1a as follows:

1. Leaves (pseudo-)verticillate.
1a. Leaves obovate .... **55. S. verticillifolia**
1a. Leaves elliptic.
2. Upper side of leaves hairy. Twigs tomentose .... **30. S. herzogii**
2. Upper side of leaves glabrous. Twigs appressedly to patently short-hairy .... **S. rayae**
1. Leaves not verticillate, *etc.*

8: 218 Add couplet 32a as follows:
32. Leaves longer than 5 cm (mean length).
32a. Leaves 14–36 by 5–11 cm. Twigs tomentose .... **S. riangensis**
32a. Leaves 3–13(–18) by 1.5–4.5(–6) cm. If leaves longer than 13 cm or broader than 4.5 cm then twigs not tomentose.
33. Flowers *etc.*

8: 227 Add couplets 5a, 5b, 15a, and 16b as follows:

4. Twigs hairy.
 5. Leaves distichous.
  5a. Leaves 14–36 cm long . . . . **S. riangensis**
  5a. Leaves at most 12 cm long . . . . **33. S. laeteviridis**
 5. Leaves spirally arranged or pseudo-verticillate.
  5b. Leaves pseudo-verticillate or at least 3–5 close together at the end of the flushes . **S. rayae**
  5b. Leaves spirally arranged.
   6. Leaves *etc.*

 15. Leaves longer than 5 cm.
  15a. Inflorescence a fascicle . . . . **S. iliaspaiensis**
  15a. Inflorescence a (short) spike, raceme, or panicle.
   16a. Inflorescence a (compound) spike . . . . **S. cochinchinensis** *ssp.* **laurina**
   16a. Inflorescence a short raceme or a panicle . . . . **42 (3). S. ophirensis** *ssp.* **cumingiana**
 14. Bracts *etc.*

8: 230 Add couplet 25a as follows:

25. Inflorescence a raceme but pedicels sometimes very short. Bracts caducous.
 25a. Leaves 15–22 cm long . . . . **36. S. maliliensis**
 25a. Leaves 3–6 cm long . . . . **S. ambangensis**
25. Inflorescence *etc.*

8: 235 Add the couplets 10a, 22a, and 22b as follows:

10. Inflorescence not a spike.
 10a. Inflorescence a fascicle . . . . **S. iliaspaiensis**
 10a. Inflorescence a raceme or panicle . . . . **42. S. ophirensis**
10. Inflorescence *etc.*

22. Leaves distichous.
 22a. Leaves 14–36 cm long . . . . **S. riangensis**
 22a. Leaves at most 12 cm long.
  23. Underside *etc.*
22. Leaves spirally arranged or pseudo-verticillate.
 22b. Leaves pseudo-verticillate or at least 3–5 close together at the end of the flushes . **S. rayae**
 22b. Leaves spirally arranged.
  29. Leaves *etc.*

8: 237 Add couplet 17a in between couplet 17:

17a. Leaves 15–22 cm long . . . . **36. maliliensis**
17a. Leaves 3–6 cm long . . . . **S. ambangensis**

or next to *S. cochinchinensis* as couplet 20a:

20. Stone different.
 20a. Leaves more than 6 cm long . . . . **16. S. cochinchinensis**
 20a. Leaves shorter than 6 cm . . . . **S. ambangensis**

Family *Symplocaceae*

Add the following species:

Symplocos rayae Noot. Blumea 30 (1984) 73.
Distr. *Malesia*: Borneo (Kalimantan Tengah, Bukit Raya, only known from the type collection).

Symplocos riangensis Noot. Blumea 30 (1984) 74.
Distr. *Malesia*: Borneo (Kalimantan Tengah, Bukit Raya).

Symplocos costatifructa Noot. Blumea 31 (1986) 277, f. 1.
Distr. *Malesia*: Borneo (Sarawak, Brunei, Sabah).

Symplocos iliaspaiensis Noot. Blumea 30 (1984) 279.
Distr. *Malesia*: Borneo (Sarawak and possibly E. Kalimantan).

Symplocos ambangensis Noot. Blumea 33 (1988) 263, f. 1.
Distr. *Malesia*: North Sulawesi (Menado, Poso).

Triuridaceae

10: 109 According to Ms. T. RÜBSAMEN (Bochum, West Germany; in litt.) the following amendments should be made:

10: 110 Family distribution map: extend the central area to the west to include part of East Africa; see Kew Bull. 36 (1982) 733.
Sciaphila BLUME.
Add/change description: Anthers sometimes 4-celled (America). Endosperm present; embryo small, orthotropous, undifferentiated, bitegmic, only in ripe seed the inner integument wholly or largely suppressed.

Violaceae

7: 198 Add under *Viola* the following species:
Viola rheophila OKAMOTO, Bull. Osaka Mus. Nat. Hist. no. 37 (1984) 4–15, 3 fig.
Distr. *Malesia*: Borneo (Kalimantan Timur)

INDEX TO SCIENTIFIC PLANT NAMES

compiled by

E.E. VAN NIEUWKOOP

Families and higher taxa have been entered under their name.

Names of families which have been revised in volumes 4–10 have been entered and are printed in bold type, so that as far as this is concerned this index is complete for all preceding volumes as well.

Suprageneric epithets have been entered under the family name to which they belong preceded by the indication of their rank (subfamilies, tribes, *etc.*).

Infrageneric epithets have been entered immediately under the generic name to which they belong, preceeded by the indication of their rank (subgenera, sections, series, *etc.*).

Infraspecific epithets have been entered under the specific name to which they belong preceded by the indication of their rank (subspecies, variety, forma, *etc.*).

Epithets of new names and *new combinations* have been printed in **bold type**, *synonyms* in *italics*.

Page numbers in **bold type** denote main treatment; an *asterisk* behind a page number denotes the presence of a figure of the concerned texon; 'map' printed behind a page number denotes that a map of the concerned taxon is present on that page.

Some minor printing errors in plant names have been corrected.

Of synonyms with a double authority, the latter has not always been cited in full. The full authority can easily be derived from the text.

FLORA MALESIANA

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